Phase I Wind Turbine Development
Site-Specific Plan of Development

<u>Prepared for:</u>
US Bureau of Land Management, Rawlins Field Office

<u>Submitted by:</u>
Power Company of Wyoming LLC

January 2015

Power Company of Wyoming LLC

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Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ac-ft	acre-feet
BA	Biological Assessment
BLM	Bureau of Land Management
BO	Biological Opinion
CCSM Phase I	Phase I of the CCSM Project
CCSM Phase II	Phase II of the CCSM Project
CCSM Project	Chokecherry and Sierra Madre Project
CCSM Project Site	Chokecherry and Sierra Madre project site
CIG Plant	Colorado Interstate Gas Rawlins Operations Facility
CO_2	carbon dioxide
cy	cubic yard
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ft	feet or foot
GWh	gigawatt hour
kN-m	kilonewton-meter
ksi	kilopound-force per square inch
LRP	limited reclamation potential
mph	miles per hour
MN-m	meganewton-meter
MW	megawatt or megawatts
NEPA	National Environmental Policy Act
NRHP	National Register for Historic Places
PCW	Power Company of Wyoming LLC
PFYC	potential fossil yield classification

PSF	pounds per square foot
Rail Facility	West Sinclair Rail Facility
RFO	Rawlins Field Office
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SSS	special status species
SWCA	SWCA Environmental Consultants
SWPP Plan	Storm Water Pollution Prevention Plan
TOTCO	The Overland Trail Cattle Company LLC
USFWS	U.S. Fish and Wildlife Service
VRM	Visual Resource Management
WGFD	Wyoming Game and Fish Department

1. CCSM Project Overview

Power Company of Wyoming LLC (PCW) proposes to construct, operate, maintain, and decommission the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project), located in Carbon County, Wyoming. The CCSM Project consists of up to 1,000 wind turbines (also referred to as wind turbine generators) capable of generating up to 3,000 megawatts (MW) of clean, renewable wind energy. The CCSM Project has a proposed life of 30 years after which, subject to market conditions, the CCSM Project may be repowered as necessary to continue its operations. The CCSM Project will provide enough electricity to power more than 790,000 households, resulting in a reduction in carbon dioxide (CO_2) emissions of 7 to 11 million tons per year.[1]

The CCSM Project is located south of the city of Rawlins, primarily within the bounds of the Overland Trail Ranch (Ranch), as shown on Figure 1-1. The Ranch is owned and operated by PCW affiliate, The Overland Trail Cattle Company LLC (TOTCO). The Ranch is situated within an area of alternating sections of private and federal lands commonly referred to as the "checkerboard." The vast majority of the private lands are owned by TOTCO, and the federal lands are administered by the Bureau of Land Management (BLM) Rawlins Field Office (RFO). A small percentage of the land within the Ranch is owned by the State of Wyoming and is administered by the State Board of Land Commissioners. Finally, Anadarko Land Corporation owns some sections located on the periphery of the northwest boundary of the Ranch.

PCW has control of the lands necessary to develop the CCSM Project. PCW has an easement from TOTCO for development of the CCSM Project on TOTCO's private land. PCW and Anadarko have executed an agreement relating to Anadarko lands where the rail facility will be located and are finalizing a wind energy development agreement. PCW has a special use lease from the State of Wyoming, Board of Land Commissioners to use certain state lands for the CCSM Project. PCW has also received a Conditional Use Permit from Carbon County for the construction, operation, maintenance, and decommissioning of the CCSM Project.

In 2008, PCW applied to BLM for right-of-way (ROW) grants to construct, operate, maintain, and decommission the CCSM Project on federal lands within the CCSM Project Area (Figure 1-1). On June 29, 2012, the Notice of Availability for the Final Environmental Impact Statement (EIS) concerning the CCSM Project was published in the Federal Register (77 FR 63328). On October 9, 2012 the Secretary of the Interior signed the Record of Decision (ROD). In the ROD, BLM determined that over 200,000 acres within the CCSM Project Area are suitable for wind energy development subject to the requirements described under the Selected Alternative in the ROD.

[1] This estimate assumes that wind generation is displacing traditional coal generation and that coal generation produces average emissions of 1,050 tons of CO_2 per gigawatt-hour (GWh) (EIA 2011, Tables A8 and A18).

Prior to issuing ROW grants, BLM committed to conduct subsequent environmental analysis of site-specific plans of development submitted by PCW. The site-specific plans of development submitted by PCW will be screened against the analysis conducted in the EIS and the requirements of the ROD. PCW anticipates submitting five (5) site-specific plans of development, consisting of the following:

1. Phase I Haul Road and Facilities
2. West Sinclair Rail Facility
3. Road Rock Quarry
4. Phase I Wind Turbine Development
5. Phase II Wind Turbine Development (including Phase II Haul Road and Facilities)

Pursuant to the SF-299, submitted herewith, PCW requests a ROW grant from BLM to construct, operate, maintain, and decommission the Phase I Wind Turbine Development, the first portion of the CCSM Project's electrical generation. The requested ROW grant is for a term of 30 years with the option to renew the ROW grant and upgrade the Phase I Wind Turbine Development, as needed. This site-specific plan of development is submitted in compliance with BLM guidance on processing ROW applications for wind energy projects on lands administered by BLM (BLM 2008a), the EIS (BLM 2012a), and ROD (BLM 2012b).

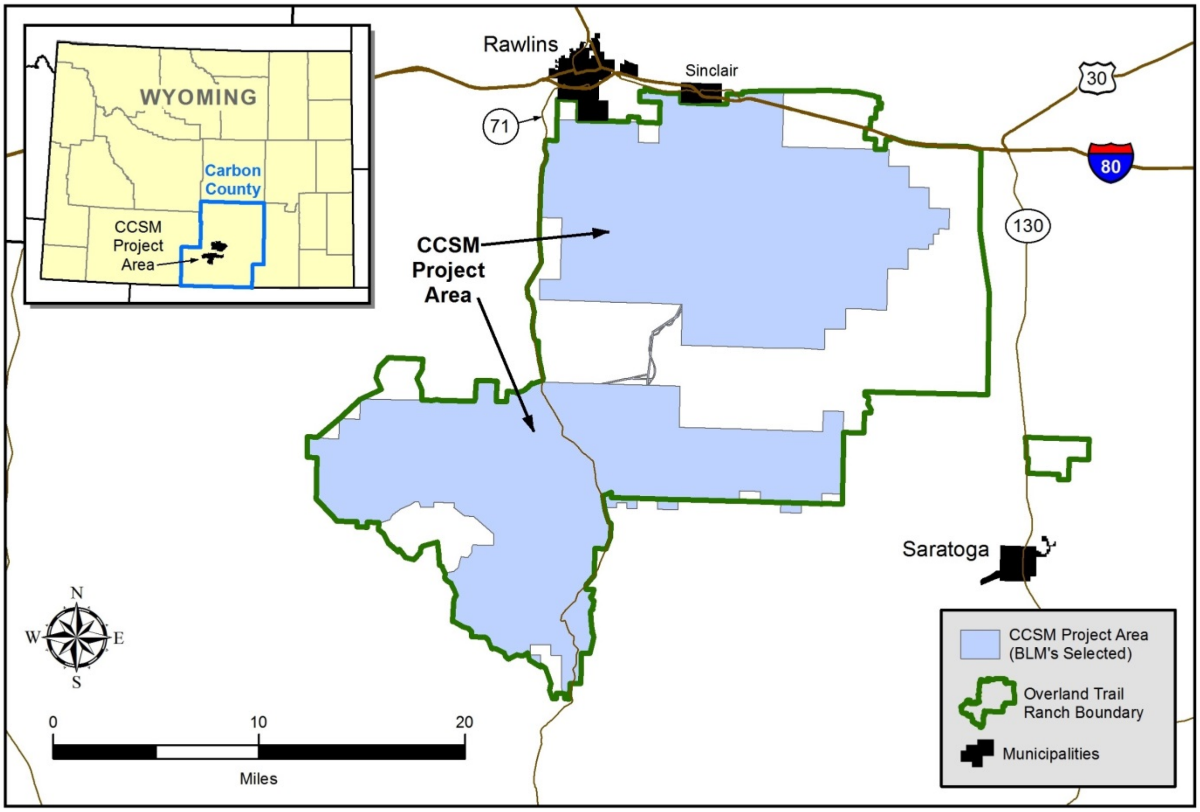

Figure 1-1. CCSM Project Area

1.1 CCSM Project Location

Figure 1-2 shows the CCSM Project Site and land ownership. As shown on Figure 1-2, the CCSM Project Site is the CCSM Project Area expressly:

(1) excluding any part of the designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3);
(2) excluding any part of the Red-Rim Grizzly Wildlife Habitat Management Area identified by BLM in the ROD for the CCSM Project signed October 9, 2012 (BLM 2012b);
(3) including portions of Sections 25 and 36 of Township 21 N, Range 87 W of the 6th P.M., Carbon County, Wyoming where the West Sinclair Rail Facility Site will be located;
(4) including portions of Section 3, Township 18N, Range 88 W of the 6th P.M., Carbon County, Wyoming within the County Road 505W right-of-way where a water line is located; and
(5) including portions of Sections 25 and 36, Township 19 N, Range 87 W of the 6th P.M., Carbon County, Wyoming to accommodate the final alignment of the Haul Road.

Consistent with the ROD, the CCSM Project Site includes off-site access on 460 acres and two (2) wind turbine development areas: “Chokecherry” is the northern wind development area (WDA) and “Sierra Madre” is the southern WDA. PCW will install wind turbines only within the two (2) wind development areas and not elsewhere within the CCSM Project Site.

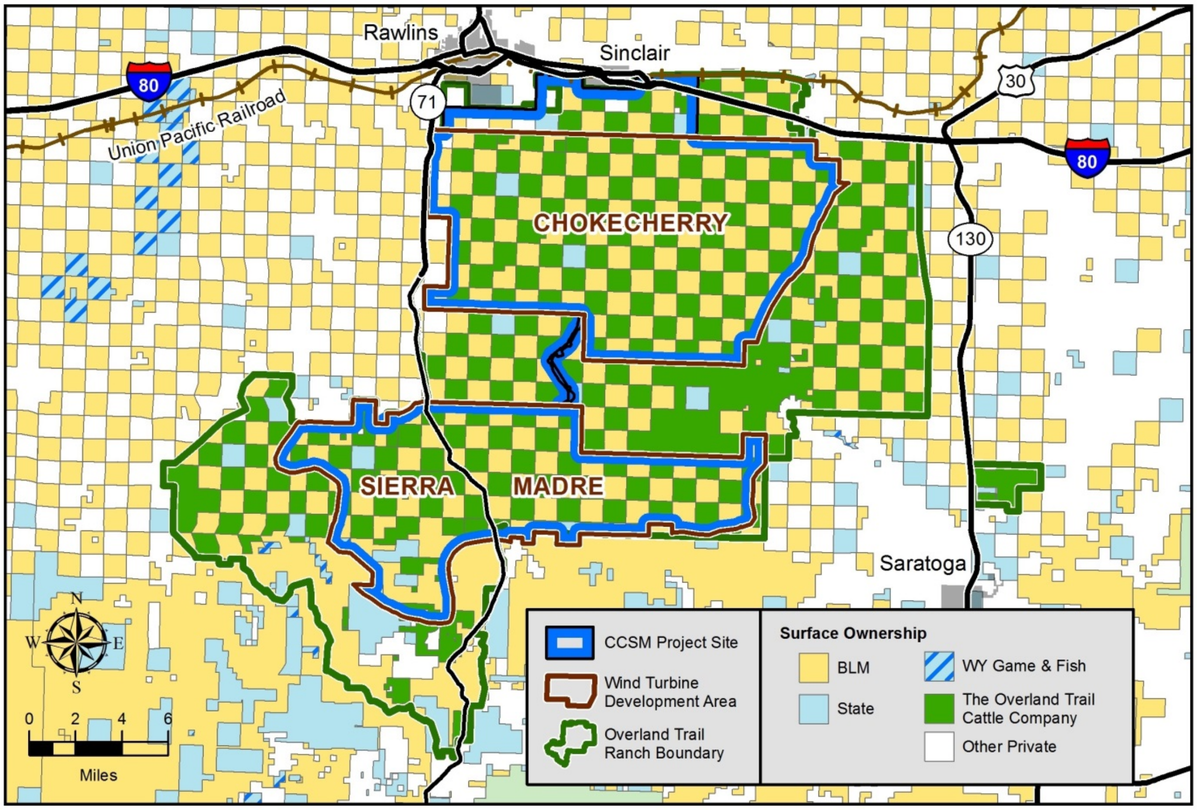

Figure 1-2. CCSM Project Site and Land Ownership

1.2 PCW's Objectives for the CCSM Project

PCW has invested seven years and more than 50 million dollars in developing the CCSM Project based on the market for power from renewable energy resources in the Desert Southwest. This market is largely a result of state mandated Renewable Portfolio Standards (RPS) requiring utilities to obtain a certain amount of their electricity from renewable sources. For example, in California, utilities must obtain 33% of their electricity from renewable resources by 2020. Nevada has an RPS of 25% by 2025, and Arizona has an RPS of 15% by 2025. Another factor is the growing recognition that there are numerous benefits to using geographically diverse renewable resources – such as smoothing out grid operations. Moreover, the demand for electricity in general is higher in the Desert Southwest due to higher and more densely concentrated populations. For instance, California is the nation's most populated state with over 38 million people, while Wyoming is the nation's least populated state with less than 600,000 people.

California market data regarding renewable energy needs from sources including Integrated Resource Plans and websites indicate that California's Investor Owned Utilities and Publicly Owned Utilities require an additional 12,423 GWh of renewable energy to meet the 33% RPS by

2020.[2] Meeting the renewable energy needs of the Desert Southwest in a cost-effective manner with wind energy from Wyoming requires a large-scale project such as the CCSM Project. The CCSM Project is uniquely aligned to meet this demand because of the CCSM Project Site's exceptional wind resources – the best onshore winds in the nation. This wind power potential was modeled by AWS Truewind Solutions and validated by the U.S. Department of Energy's National Renewable Energy Laboratory as Class 5 (excellent), Class 6 (outstanding) or Class 7 (superb).

The Desert Southwest market is located 800 miles from the CCSM Project. Because the CCSM Project will serve the demands of a distant market, the price of the power must include the additional cost of long-distance transmission. As a result, the economic viability of the CCSM Project is based on developing Wyoming's high capacity winds in a large-scale size project. PCW has determined that developing the CCSM Project with a total of 1,000 turbines with an installed capacity of 3,000 MW[3] in two phases of 500 turbines (1,500 MW) each will achieve its purpose and need. This overall size and phased approach is supported by the current market for renewable energy in the Desert Southwest and independent studies by both the National Renewable Energy Laboratory (NREL) and the Western Electric Coordinating Council (WECC).

In March 2014, the National Renewable Energy Laboratory, Department of Energy, released its report, "California-Wyoming Grid Integration Study, Phase 1- Economic Analysis."[4] The analysis compared two basic options for meeting California's need for 12,000 GWh per year of renewable energy between 2017 and 2020. The study analyzed satisfying California's demand from in-state renewable resources located near the consumer versus transmitting Wyoming wind to California to meet the demand. The study concluded that delivering 12,000 GWh of Wyoming wind via a 3,000 MW direct current transmission line[5] competed favorably with in-state resources providing significant economic benefits to California ratepayers.[6]

In 2011, the Western Electricity Coordinating Council examined the economics of regional transmission and generation scenarios in its "10-Year Regional Transmission Plan."[7] According to this Department of Energy-funded economic analysis, meeting California's renewable energy demand with 12,000 GWh of Wyoming wind was cost-effective when compared to in-state and

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[2] Southern California Edison, 2014 Renewables Portfolio Standard Procurement Plan 6.6; Pacific Gas and Electric Company, 2014 Renewables Portfolio Standard Procurement Plan 6.6; Los Angeles Department of Water and Power, www.ladwp.com; Southern California Public Power Authority, www.scppa.org and Energy Strategies.
[3] Estimated to produce approximately 12,000 GWh of electricity per year based upon a 45% capacity factor.
[4] http://www.nrel.gov/docs/fy14osti/61192.pdf
[5] A 3,000 MW Direct Current Transmission line can initially be built with a 1,500 MW capacity and later upgraded to 3,000 MWs.
[6] *Id.*
[7] *See* 10-Year Regional Transmission Plan, Plan Summary, WECC, September 2001; https://www.wecc.biz/Reliability/2011_Plan_Summary.pdf

other out-of-state resources, considering the cost of generation and transmission. Both of these studies were based upon large-scale wind and transmission projects.

Developing the CCSM Project in two phases of 1,500 MW is not only supported by the market demand increasing from now through 2020 and beyond, but also by other market requirements. In October 2014, the California Public Utilities Commission (CPUC) updated its guidance relating to achieving California's Renewable Portfolio Standard goals, as part of its "RPS Calculator" analysis and modeling. When considering out-of-state generation and transmission projects as part of their RPS Calculator process, the CPUC will only consider projects with at least 1,500 MW of capacity.[8]

In sum, the CCSM Project is designed to achieve a balance between renewable energy demands, economics, and environmental sensitivities. PCW's overall objectives for the CCSM Project are:

1. Extracting the maximum potential wind energy from the site;
2. Developing a 1,000 wind turbine project with an installed capacity of between 2,000 MW and 3,000 MW in two phases of 1,500 MW each;
3. Developing the highest wind energy potential areas first; and
4. Constructing the CCSM Project as rapidly as possible on an optimized schedule.

Each element of PCW's objectives is described in detail in the Plan of Development for the CCSM Project (PCW 2012). BLM determined in the ROD that over 200,000 acres of the CCSM Project Area are suitable for wind energy development and that the Selected Alternative meets BLM's purpose and need and takes into account PCW's objectives (BLM 2012a).

1.3 Federal Approvals

In 2008, PCW applied to BLM for ROW grants to construct, operate, maintain, and decommission the CCSM Project on federal lands within the CCSM Project Area. Over the next four (4) years, BLM conducted extensive public scoping, performed numerous studies and surveys, analyzed multiple alternatives and prepared a Draft EIS for the CCSM Project, which was published for public comment on July 22, 2011. BLM took the next year to review and incorporate public comments on the Draft EIS and further refine its analysis. On June 29, 2012, the Notice of Availability for the Final EIS concerning the CCSM Project was published in the Federal Register (77 FR 63328). On October 9, 2012, the Secretary of the Interior signed the ROD for the CCSM Project. In the ROD, BLM determined that 219,707 acres are suitable for wind energy development and associated facilities on federal lands - consisting of the 109,086-

[8] http://www.cpuc.ca.gov/PUC/energy/Renewables/RPS+Proceeding+Materials+Version+6.htm

ac Chokecherry site and the 110,161-ac Sierra Madre site and off-site access on 460 ac - subject to the requirements as described under the Selected Alternative in the ROD.

Prior to issuing ROW grants, BLM will conduct subsequent environmental analysis of site-specific plans of development submitted by PCW. The site-specific plans of development will be screened against the analysis conducted in the EIS and the requirements described under the Selected Alternative in the ROD. Then, prior to issuing ROW grants, BLM will conduct the appropriate level of additional environmental analyses tiering to the EIS and decisions outlined in the ROD. Future siting of wind turbine generators and associated site-specific plans of developments will be submitted consistent with the strategy adopted in the ROD. See Appendix C of the ROD, which contains a detailed description and flow chart regarding the National Environmental Policy Act (NEPA) tiering procedures to be used.

The timing and order of the submission of the site-specific plans of development to BLM will align with PCW's plan to develop the CCSM Project in two (2) phases. Phase I requires the installation of a nameplate capacity of at least 1,500 MW of wind energy generation facilities (approximately 500 turbines). Construction of Phase I of the CCSM Project (CCSM Phase I) is anticipated to begin in the second half of 2015. Completion of construction and commencement of commercial operation of Phase I is anticipated for 2017. Phase II of the CCSM Project (CCSM Phase II), consisting of development of the remainder of the CCSM Project, is anticipated to follow completion of Phase I. Each site-specific plan of development will contain engineering and natural resource data describing site-specific conditions and activities in the detail necessary to allow BLM to evaluate and analyze site-specific impacts. Appropriate avoidance, minimization, and mitigation measures have been applied consistent with the ROD (Appendix A).

2. Phase I Wind Turbine Development Overview

The Phase I Wind Turbine Development represents the first half of the CCSM Project's electrical generation. The Phase I Wind Turbine Development includes 500 wind turbines and associated elements for the CCSM Project such as roads, electrical lines, substations, operation and maintenance buildings, meteorological towers, utilities, and temporary construction features. Each element of the Phase I Wind Turbine Development is described in detail in Section 4.3. Construction, operation, maintenance, and decommissioning of the Phase I Wind Turbine Development relies on the infrastructure to be built for the Phase I Haul Road and Facilities, West Sinclair Rail Facility, and Road Rock Quarry, collectively referred to as the CCSM Project Infrastructure Components.

The Phase I Wind Turbine Development provides half of the electricity needed to generate renewable energy that meets the objectives of the CCSM Project described in Section 1.2. The Phase I Wind Turbine Development is designed to extract the maximum potential wind energy from the Phase I Wind Turbine Development Site while complying with the requirements of BLM's Selected Alternative. PCW's objectives for the Phase I Wind Turbine Development are:

1. Extracting the maximum potential wind energy from the Phase I Wind Turbine Development Site;
2. Developing 500 wind turbines on the Phase I Wind Turbine Development Site with an installed capacity of at least 1,500 MW;
3. Constructing the Phase I Wind Turbine Development as rapidly as possible on an optimized schedule; and
4. Constructing the Phase I Wind Turbine Development efficiently and cost-effectively.

PCW's objectives for the Phase I Wind Turbine Development are aligned with and further the overall objectives of the entire CCSM Project and meet PCW's needs for the CCSM Project based on economic viability, market requirements, and market demand (Section 1.2).

The Phase I Wind Turbine Development is located within the CCSM Project Site in Carbon County, Wyoming (Table 2.1). The Phase I Wind Turbine Development Site consists of 3,035 acres of initial disturbance, 485 acres of long-term disturbance, and 440 acres of activity areas (Figure 2-1 and Table 2.2). Activity areas are defined areas where project activities may occur that do not require ground disturbance. The Phase I Wind Turbine Development is located on a combination of federal lands, private lands, and state lands (Table 2.1).

The location of the Phase I Wind Turbine Development is consistent with the Selected Alternative in the ROD, including the avoidance, minimization, and mitigation measures. PCW has designed the Phase I Wind Turbine Development to meet PCW's objectives and the requirements of the CCSM Project, while complying with BLM's Selected Alternative.

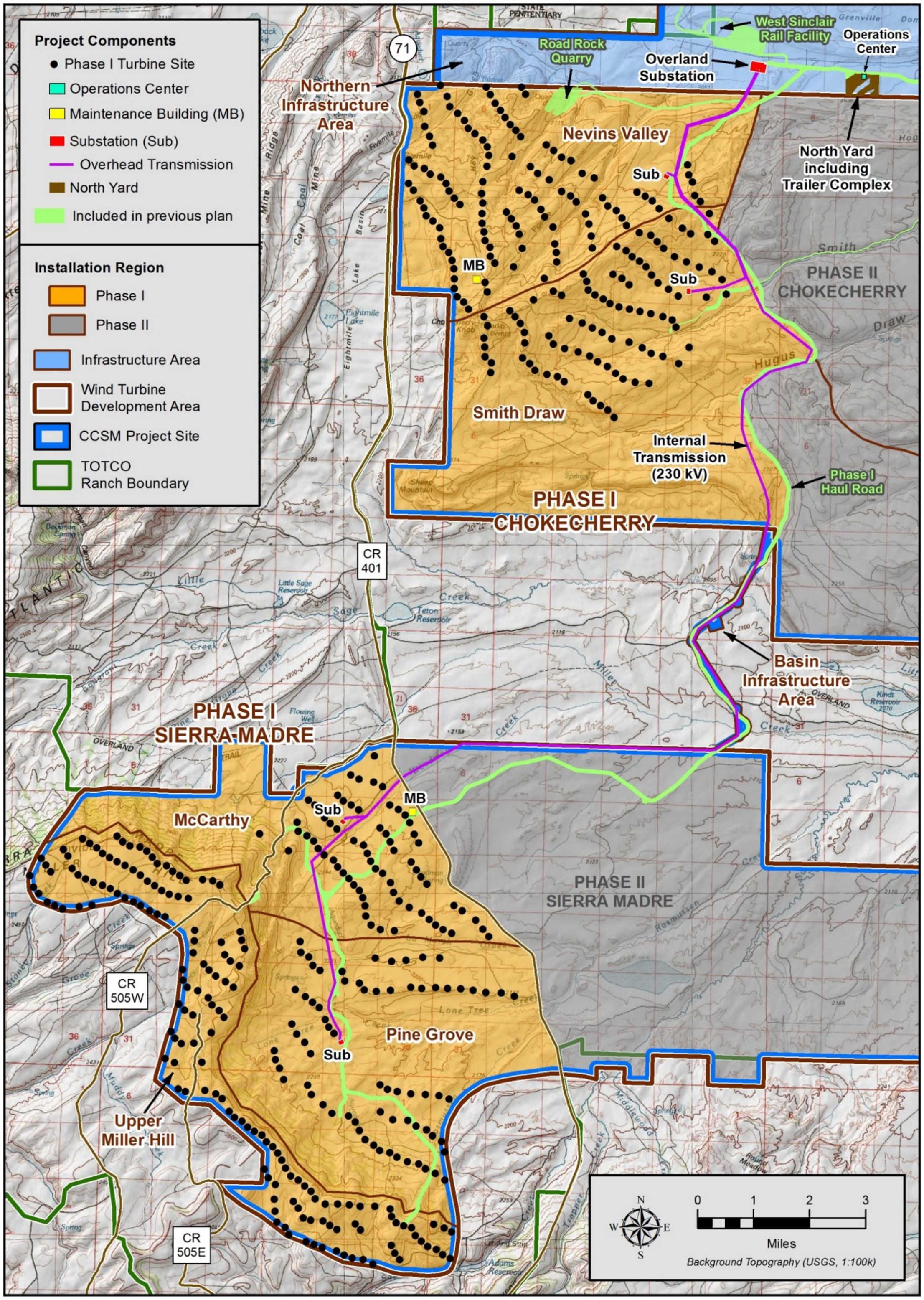

Figure 2-1. Phase I Wind Turbine Development Site

Table 2.1. Phase I Wind Turbine Development Location

Township	Range	Section(s)	Ownership
21 N	86 W	31, 33	TOTCO
21 N	86 W	32	BLM
21 N	87 W	24	TOTCO
21 N	87 W	33	Anadarko Land Corp.
21 N	87 W	32	BLM
20 N	86 W	31	TOTCO
20 N	86 W	30	BLM
20 N	87 W	1, 2, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 26, 27, 29, 31, 33, 35	TOTCO
20 N	87 W	2, 6, 8, 10, 14, 18, 20, 22, 24, 26, 28, 30, 32, 34	BLM
20 N	87 W	16, 36	State Land Board
20 N	88 W	1, 13	Anadarko Land Corp.
20 N	88 W	12, 14, 24	BLM
19 N	86 W	7	TOTCO
19 N	87 W	1, 3, 13, 23, 25, 31, 33, 35	TOTCO
19 N	87 W	12, 24, 26, 34	BLM
19 N	87 W	36	State Land Board
18 N	87 W	1, 3, 5, 7, 19, 29	TOTCO
18 N	87 W	2, 4, 6, 18, 20, 30	BLM
18 N	88 W	1, 3, 7, 9, 10, 11, 13, 15, 17, 19, 21, 22, 23, 24, 25, 26, 27, 29, 33, 34, 35	TOTCO
18 N	88 W	2, 10, 12, 14, 18, 20, 22, 26, 28, 32, 34, 35	BLM
18 N	88 W	16	State Land Board
18 N	89 W	11, 13, 23	TOTCO
18 N	89 W	12, 14, 24	BLM
17 N	87 W	18, 19	TOTCO
17 N	87 W	6, 7, 18, 19	BLM
17 N	87 W	7	State Land Board
17 N	88 W	1, 2, 3, 11, 12, 13, 14, 23, 24	TOTCO
17 N	88 W	1, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 24	BLM
17 N	88 W	2, 3, 11, 15, 22, 23	State Land Board
17 N	88 W	5	Wyoming Game & Fish Department

Table 2.2 Phase I Wind Turbine Development Land Ownership

Ownership	Initial Disturbance (acres)	Long-term Disturbance (acres)	Activity Area (acres)
Private	1,568	256	264
Federal	1,346	211	153
State	121	18	23
TOTAL	3,035	485	440

3. Phase I Wind Turbine Development Execution and Resource Use

The CCSM Project construction schedule and the associated resource use are summarized below to assist in the evaluation of the Phase I Wind Turbine Development in the context of the CCSM Project as a whole. The estimated resource usage for the Phase I Wind Turbine Development, as well as for the remainder of the CCSM Project, is included in the following sections for comparison to the resource use analyzed in the EIS.

3.1 Construction Schedule

PCW will construct the CCSM Project in two (2) phases, as described in Section 1.3. CCSM Phase I construction is expected to begin in late 2015 with construction of the infrastructure components, and be complete in 2019, with Phase I Wind Turbine Development construction beginning in 2016. CCSM Phase II is anticipated to follow completion of Phase I.

PCW will construct CCSM Phase I over a five (5) year period (Table 3.1). The CCSM Phase I schedule is designed to first open the site to road and rail access, then establish the onsite quarry, and finally proceed with wind turbine construction. In accordance with PCW objective number three (3) for the CCSM Project, developing the highest wind energy potential areas first, the Phase I Sierra Madre WDA will be constructed first followed by Phase I of the Chokecherry WDA. PCW anticipates the installation of 229 turbines in 2018 and another 271 turbines in 2019. Similar to Phase I, the wind turbines and associated infrastructure for Phase II will be constructed over a three year period, with the wind turbines installed during the last two years.

Table 3.1. CCSM Phase I Construction Schedule

Facility	2015	2016	2017	2018	2019[1]
Phase I Haul Road and Facilities					
Roads	Construct	Construct			
Laydown yards	Construct	Construct	Operate	Operate	Operate
Water facilities	Construct	Construct	Operate	Operate	Operate
West Sinclair Rail Facility					
Rail Facility		Construct	Construct	Operate	Operate
Access road	Construct				
Laydown yards		Construct	Construct	Operate	Operate
Road Rock Quarry					
Quarry	Construct	Mobilize & Operate	Operate	Operate	Operate
Access road	Construct				
Phase I Wind Turbine Development					
Roads			Construct	Construct	Construct
Turbine sites			Construct	Construct	Construct
Turbine installation				Construct	Construct
Substations and Transmission				Construct	Construct
Facilities		Construct	Construct	Construct	Construct

Notes:
1. Reclamation activities associated with CCSM Phase I construction will extend beyond 2019.

3.2 Labor

The EIS evaluated the impacts associated with the CCSM Project workforce. For construction of the CCSM Project, the EIS analyzed a peak workforce of 1,200 workers. The current CCSM Project workforce estimates reflect a reduced peak construction workforce of 945 workers. The workforce required to construct the Phase I Wind Turbine Development is anticipated to peak at 761 workers in 2018. Table 3.2 and Figure 3-1 detail the CCSM Project construction workforce, as well as the portion specifically supporting construction of the Phase I Wind Turbine Development.

Table 3.2. CCSM Project Construction Workforce

Year	***EIS Analysis***	**Current CCSM Project Estimate**	
	Total Project Peak Workforce	**Total Project Peak Workforce**	**Phase I Wind Turbine Development**
2015	*N/A*	84	0
2016	*300*	255	16
2017	*400*	390	259
2018	*1,200*	945	761
2019	*1,200*	883	701
2020	*1,000*	301	0
2021	*N/A*	925	0
2022	*N/A*	881	0
PEAK	***1,200***	**945**	**761**

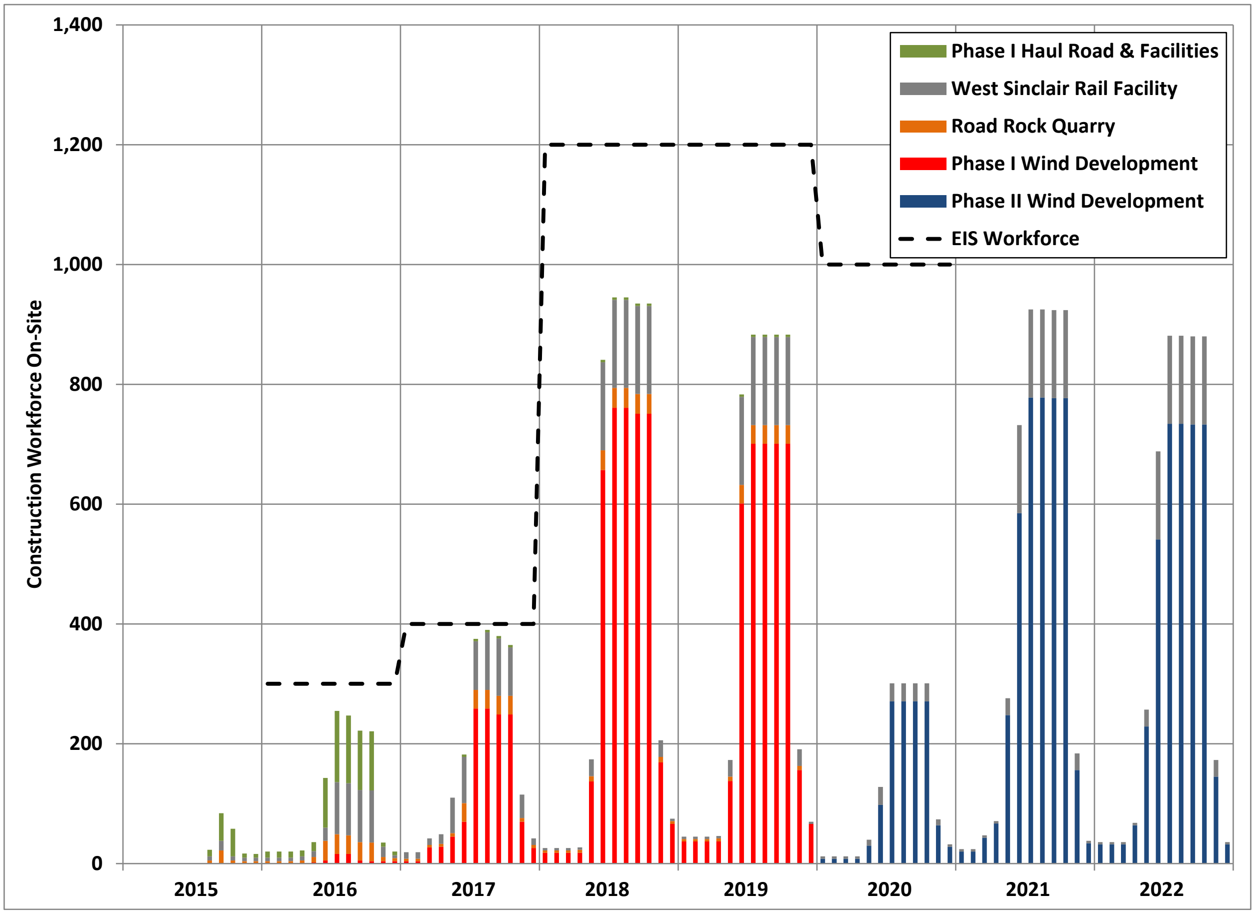

Figure 3-1. CCSM Project Construction Workforce

For the operations stage of the CCSM Project, the EIS evaluated the impacts of a workforce of 158 workers. The CCSM Project operations workforce will be brought on-site gradually as construction is completed. At the completion of Phase I construction, PCW is currently estimating that the CCSM Project's operations workforce will consist of 64 workers. Following construction of Phase II of the CCSM Project, the operations workforce is anticipated to grow to 114 workers. Table 3.3 and Figure 3-2 summarize the CCSM Project operations workforce.

Table 3.3. CCSM Project Operations Workforce Buildup

Year	***EIS Analysis***	**Current CCSM Project Estimate**
	Total Operations Workforce	**Total Operations Workforce**
2015	*158*	0
2016		0
2017		0
2018		40
2019		64
2020		64
2021		89
2022 and beyond		114
PEAK	***158***	**114**

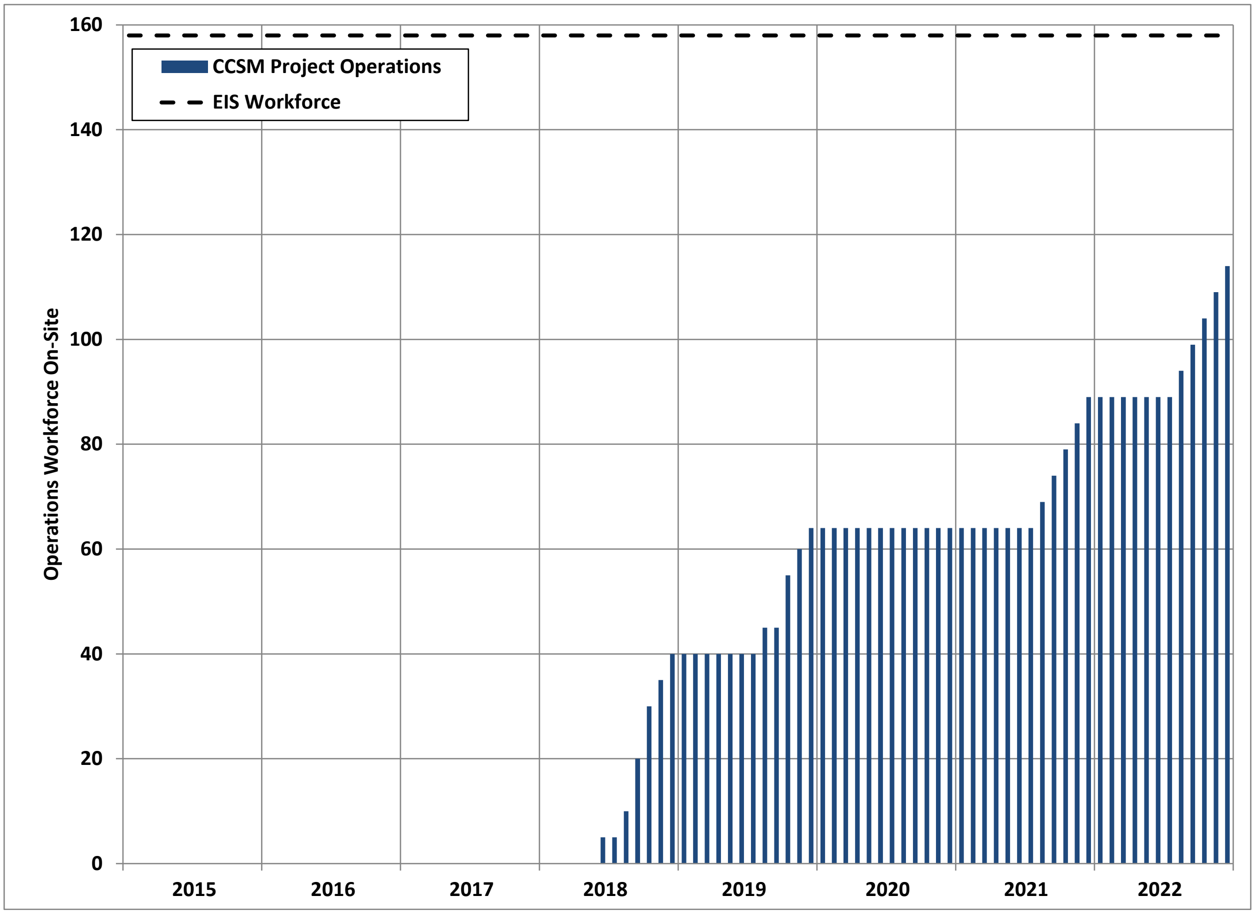

Figure 3-2. CCSM Project Operations Workforce

To decommission the CCSM Project, the EIS evaluated a workforce of up to 400 workers. PCW currently estimates the peak decommissioning workforce at 396, including the workforce necessary to decommission the Phase I Wind Turbine Development. Table 3.4 and Figure 3-3 summarize the CCSM Project decommissioning workforce.

Table 3.4 CCSM Project Decommissioning Workforce Estimate

Year	*EIS Analysis* *Peak Decommissioning Workforce*	Current CCSM Project Estimate Peak Decommissioning Workforce
Year 1	*400*	387
Year 2	*400*	396
Year 3	*400*	385
PEAK	***400***	**396**

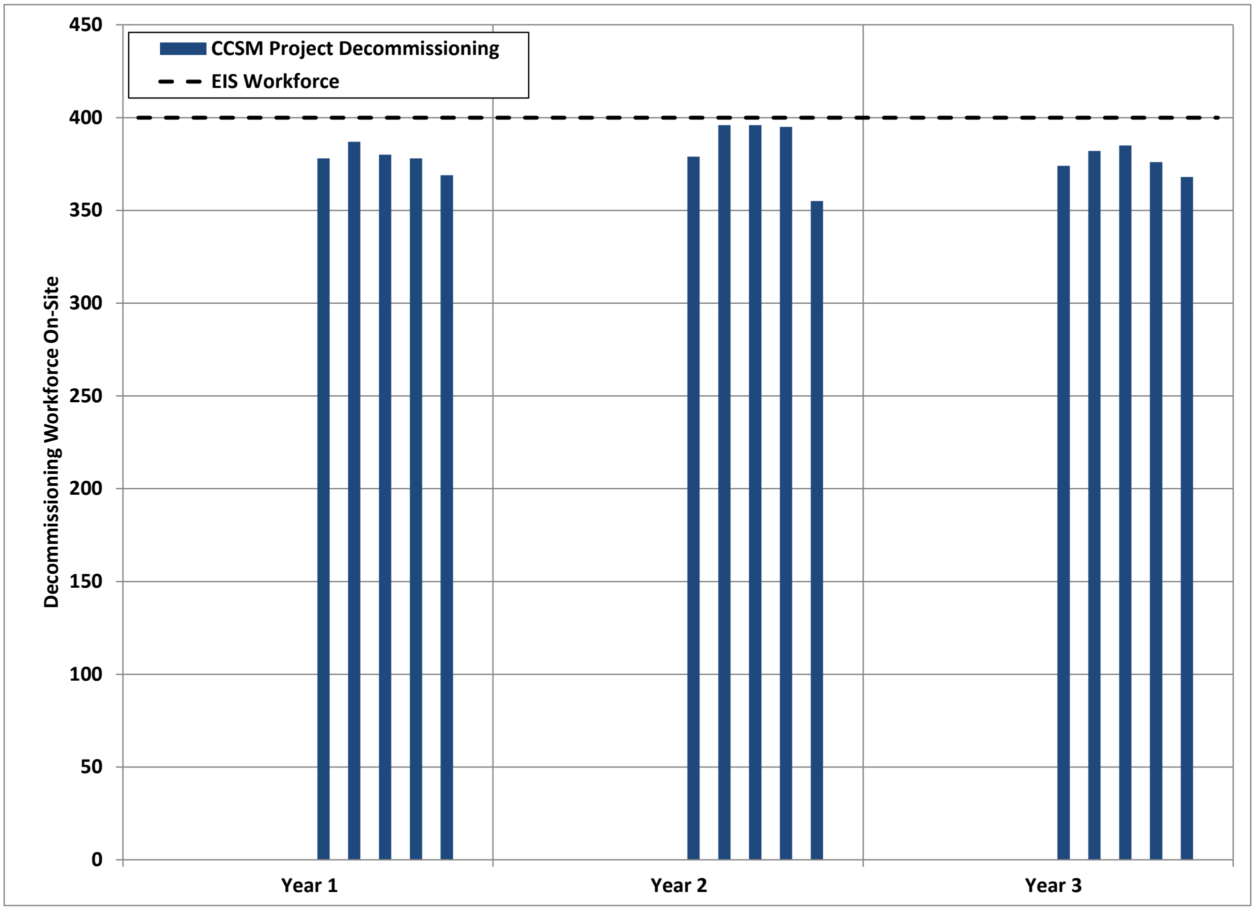

Figure 3-3. CCSM Project Decommissioning Workforce

3.3 Equipment

PCW has estimated the amount of equipment required to construct, operate, maintain, and decommission the CCSM Project. The estimated annual peak amount of equipment for the CCSM Project is shown in Table 3.5 and Figure 3-4 below. The specific types of equipment and the number of each required for the Phase I Wind Turbine Development are provided in Section 5.4.

Table 3.5. Peak Construction Equipment Estimate

Year	General Pick-Ups		Other Equipment		Total Equipment	
	EIS	Current	EIS	Current	EIS	Current
2015	*200*	31	*200*	43	*400*	74
2016	*350*	92	*200*	166	*550*	258
2017	*850*	151	*400*	193	*1,250*	344
2018	*900*	347	*450*	451	*1,350*	798
2019	*750*	314	*300*	414	*1,050*	728
2020	*N/A*	125	*N/A*	221	*N/A*	346
2021	*N/A*	352	*N/A*	494	*N/A*	846
2022	*N/A*	316	*N/A*	464	*N/A*	780
Operations and Maintenance	N/A	60	N/A	10	N/A	70
Decommissioning	N/A	230	N/A	150	N/A	380

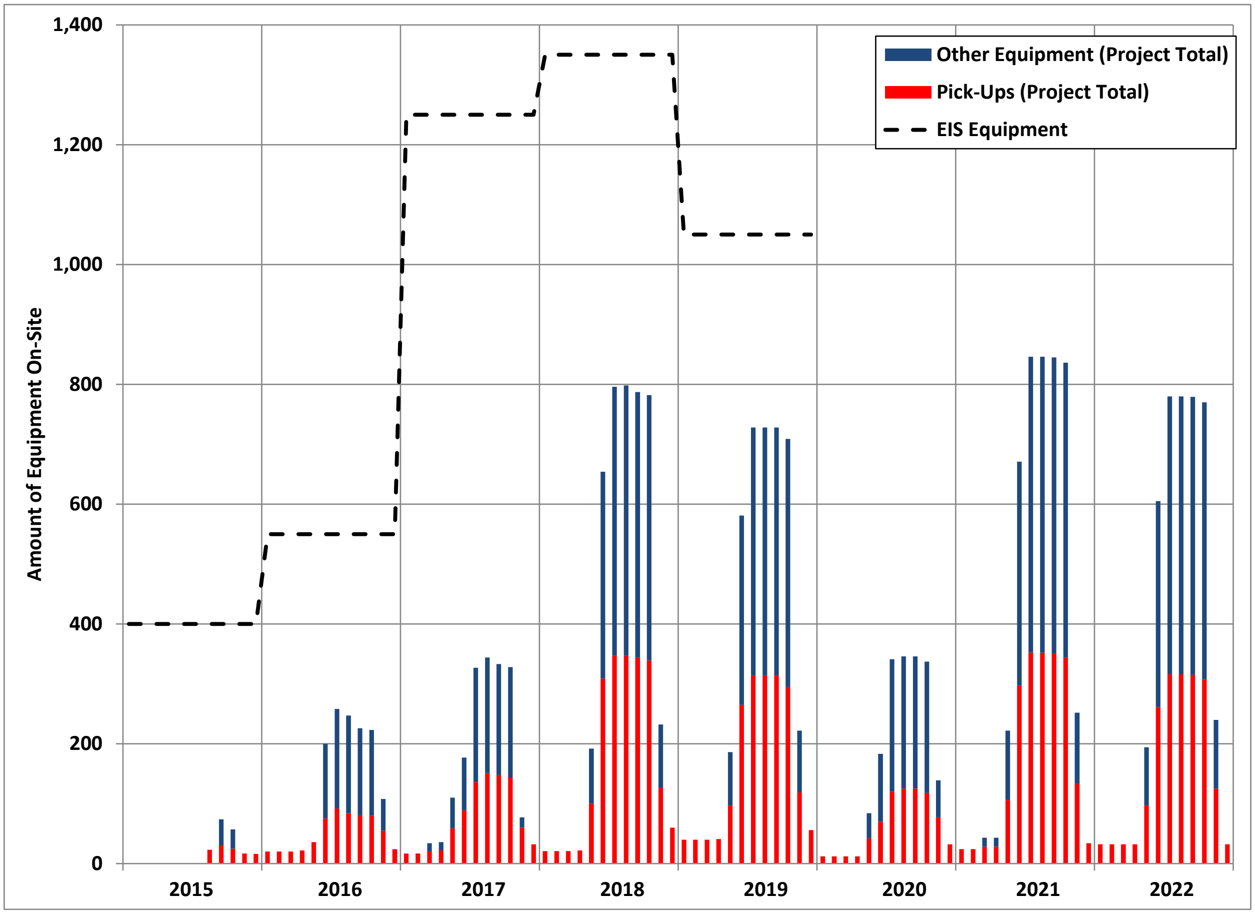

Figure 3-4. Peak Equipment During Construction

3.4 Material

Aggregate is the highest volume material required to construct the Phase I Wind Turbine Development. PCW estimates that the amount of aggregate required to build the entire CCSM Project is approximately 2.7 million cubic yards (cy), as shown in Table 3.6 and Figure 3-5. The EIS analyzed 2.8 million cy of material. The aggregate will be obtained both on-site and from nearby commercial sources. Aggregate is also required to operate and maintain the CCSM Project; however, the annual amount required for operations and maintenance activities is anticipated to be minimal. Aggregate will be removed as part of the decommissioning process, thus no additional aggregate will be required for decommissioning. Other components and material required to construct the Phase I Wind Turbine Development scope are discussed in Section 5.5.

Table 3.6. CCSM Project Construction Aggregate Estimate

Year	Source		Requirements	
	On-site (cy)	Off-site (cy)	CCSM Project TOTAL (cy)	Phase I Wind Turbine Development (cy)
2015	0	36,000	36,000	0
2016	489,000	134,000	623,000	0
2017	570,000	348,000	918,000	348,000
2018	168,000	28,000	196,000	196,000
2019	107,000	23,000	130,000	130,000
PHASE I TOTAL	**1,334,000**	**569,000**	**1,903,000**	**674,000**
2020	300,000	62,000	362,000	0
2021	233,000	39,000	272,000	0
2022	142,000	46,000	188,000	0
PHASE II TOTAL	**675,000**	**147,000**	**822,000**	**0**
CCSM PROJECT TOTAL	**2,009,000**	**716,000**	**2,725,000**	**674,000**

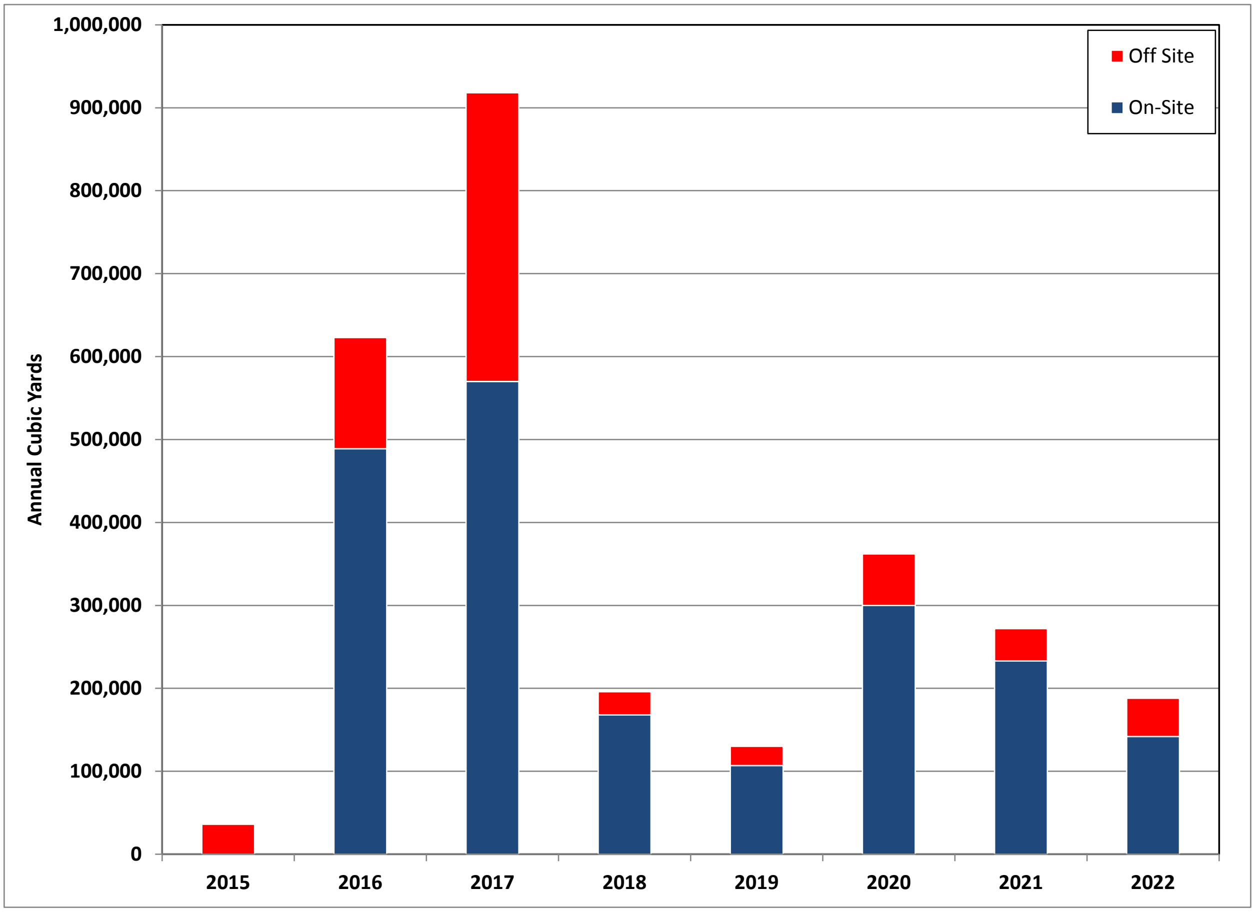

Figure 3-5. Material Estimate During Construction

3.5 Water

The EIS analyzed a total of 553 acre-feet (ac-ft) of water consumption for construction of the CCSM Project, with a peak annual use of 168 ac-ft as shown in Table 3.7. The current construction water consumption estimate for the CCSM Project is a total of 604 ac-ft with a peak annual use of 106 ac-ft as shown in Figure 3-6. While the current estimate adds the water requirements of the Road Rock Quarry (55 ac-ft over the life of the quarry), the peak annual consumption has been reduced 60 ac-ft from the EIS peak. Potable water demand for construction of the CCSM Project is variable and highly dependent upon the requirements of the construction camp. Potable water demand during construction for uses other than the construction camp is anticipated to be minimal. The water required to meet potable water demands during construction, including the construction camp demand, will likely come from municipal sources.

The water consumption for operations, maintenance and decommissioning of the CCSM Project is anticipated to be minimal; less than 50 ac-ft per year during operations and maintenance and less than 100 ac-ft per year during decommissioning. Consistent with the analysis in the EIS, PCW will make use of existing water resources by using existing water rights as well as taking advantage of municipal supplies when available such that water use will not impact current water users or interstate agreements (BLM 2012a).

The CCSM Project water use estimate assumes that only water will be used for dust control. PCW is requesting that BLM approve the use of magnesium chloride as an alternative dust control measure to improve the longevity of dust control which will reduce water use for dust suppression.[9] If the use of magnesium chloride is approved, water requirements may be reduced by as much as 30 percent.

Table 3.7. CCSM Project Construction Water Use Estimate

Year	*EIS Analysis (acre-feet)*	Current CCSM Project Plan (acre-feet)
2015	*38*	15
2016	*109*	82
2017	*151*	105
2018	*168*	79
2019	*87*	58
2020	*N/A*	94
2021	*N/A*	93
2022	*N/A*	78
PEAK	***168***	**105**
TOTAL	***553***	**604**

[9] In accordance with current BLM policy, PCW will not apply chloride compounds or lignin derivatives within 500 feet of a perennial stream on federal lands.

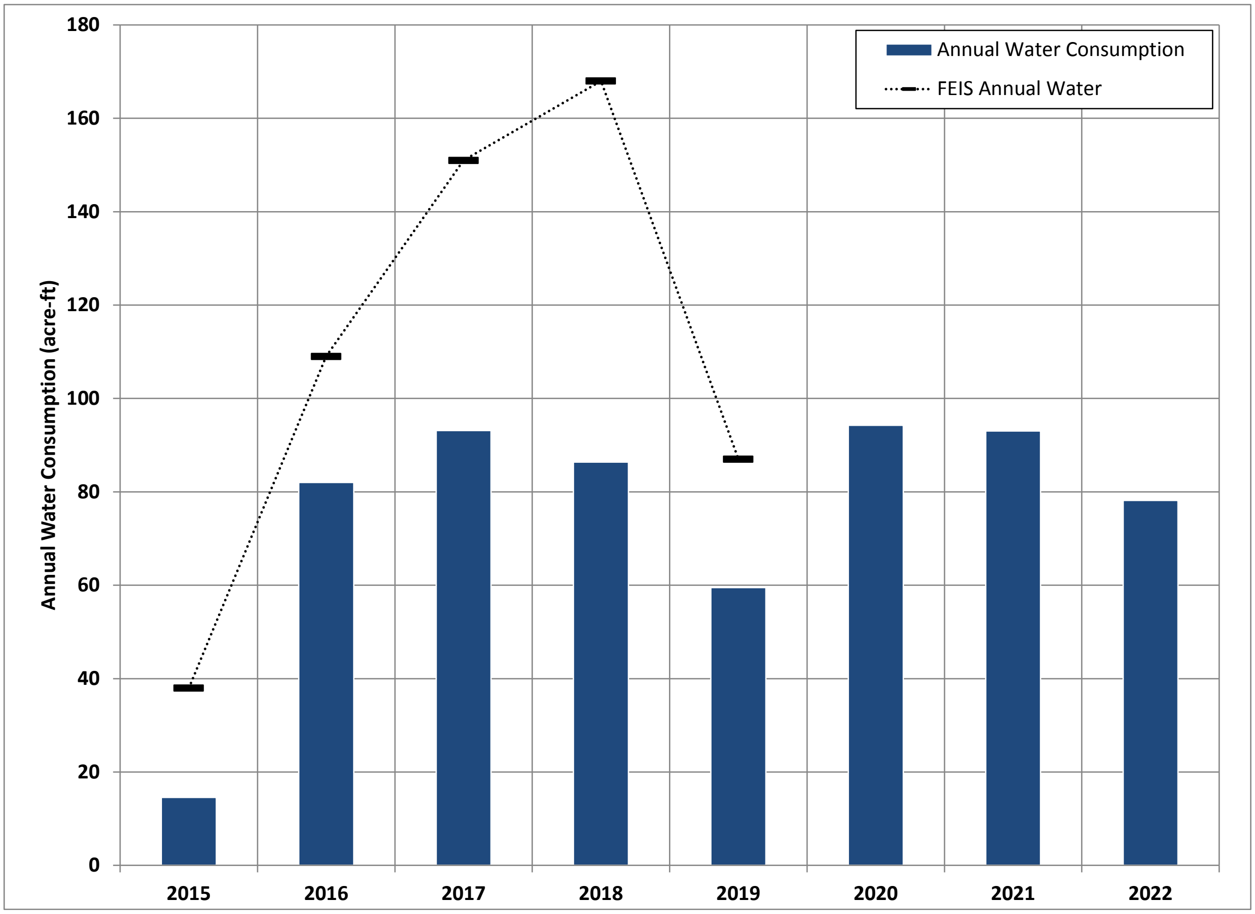

Figure 3-6. Water Use Estimate During Construction

3.6 Surface Disturbance

The initial surface disturbance for the CCSM Project analyzed in the EIS was 7,733 acres, with a long-term disturbance of 1,545 acres (BLM 2012a). Table 3.8 and Figure 3-7 show the estimated initial and long-term disturbance for the CCSM Project by site-specific plan of development and cumulatively for comparison to the EIS. While these estimates may be refined in future site-specific plans of development, the disturbance estimates presented below represent the best available information.

Table 3.8. Surface Disturbance Estimate

Site-specific Plan of Development	Initial Disturbance (ac)	Long-Term Disturbance (ac)	Activity Area (ac)
Phase I Haul Road & Facilities	875	225	0
West Sinclair Rail Facility	370	121	0
Road Rock Quarry	184	18	0
Phase I Wind Turbine Development	3,035	485	440
Phase II Wind Development	2,866	482	409
CURRENT DISTURBANCE ESTIMATE	**7,330**	**1,331**	**N/A**
EIS DISTURBANCE ESTIMATE	**7,733**	**1,545**	***N/A***
CHANGE	***-403***	***-214***	***N/A***

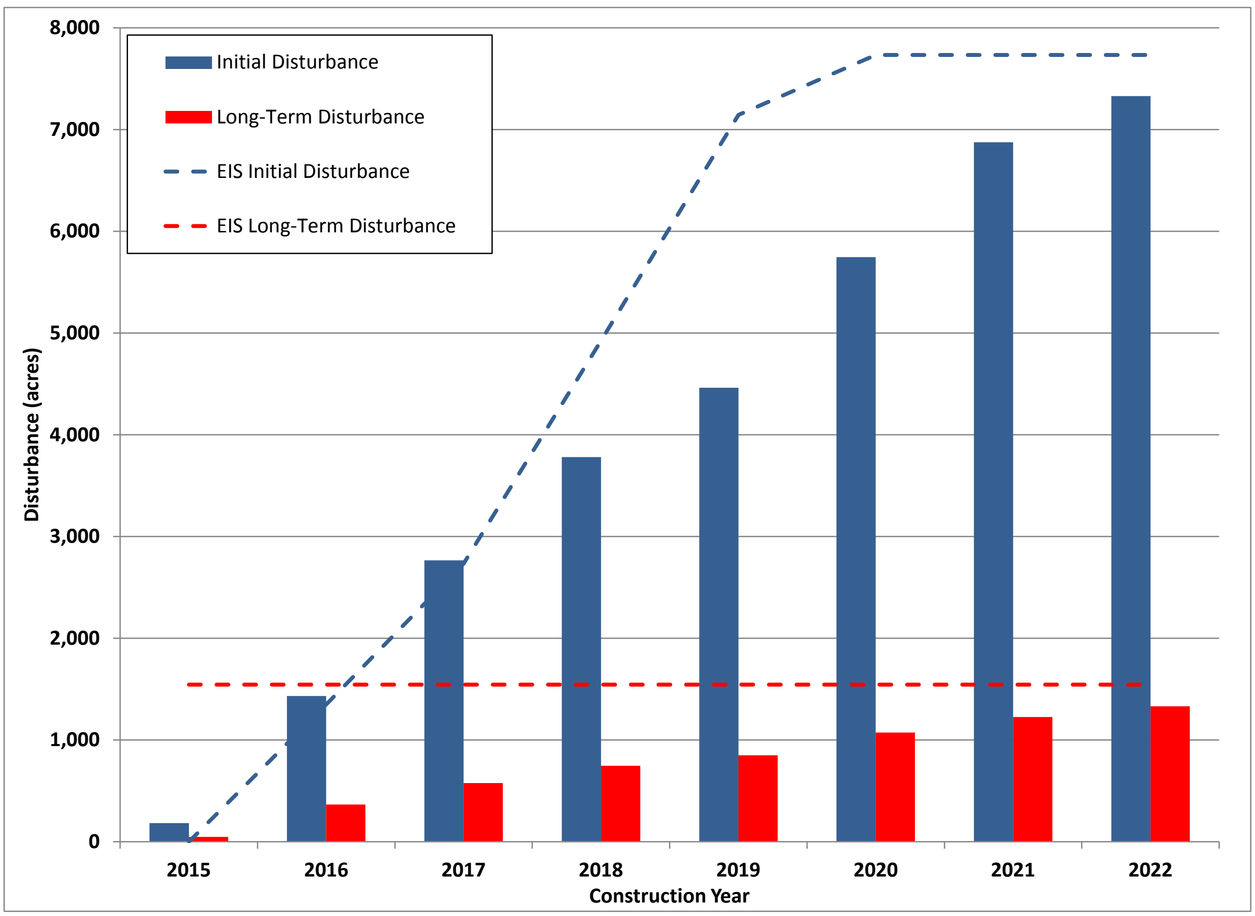

Figure 3-7. Surface Disturbance Estimate

4. Phase I Wind Turbine Development Design

As described in Section 2, the Phase I Wind Turbine Development consists of 500 wind turbines and associated elements for the CCSM Project such as roads, electrical lines, substations, operation and maintenance buildings, meteorological towers, and utilities. The Phase I Wind Turbine Development also includes temporary construction features such as laydown yards, crane assembly areas, and on-site accommodations (construction camp and RV park). This section provides an overview of the Phase I Wind Turbine Development design and describes how this design meets the CCSM Project requirements and objectives in an efficient and effective manner. Each element of the Phase I Wind Turbine Development is described in detail in Section 4.3.

4.1 Layout

As described in Section 1.2, the CCSM Project is designed to achieve a balance between renewable energy demands, economics, and environmental sensitivities. PCW's objectives for the CCSM Project include extracting the maximum potential wind energy from the site, as well as constructing the CCSM Project as rapidly as possible on an optimized schedule. These objectives both affect the design of the Phase I Wind Turbine Development. In addition to meeting PCW's objectives, the Phase I Wind Turbine Development design must also comply with the requirements of the ROD, account for the requirements and recommendations of the various equipment vendors involved in the CCSM Project, and incorporate other agency constraints.

The Phase I Wind Turbine Development Site is shown on Figure 2-1. In compliance with BLM's Selected Alternative, the 500 turbines for the Phase I Wind Turbine Development are located within the Phase I portions of the Chokecherry and Sierra Madre WDAs. For purposes of this site-specific plan of development, each WDA is further broken down into wind turbine installation regions, as shown on Figure 4-1 and Figure 4-2 and detailed in Table 4.1.

Table 4.1. Wind Turbine Installation Regions

Region	Number of Turbines
Chokecherry WDA	**202**
Nevins Valley[1]	112
Smith Draw[1]	90
Sierra Madre WDA	**298**
Upper Miller Hill	157
McCarthy[2]	69
Pine Grove[2]	72
TOTAL	**500**
Notes: 1 = collectively referred to as Nevins Ridge 2 = collectively referred to as Lower Miller Hill	

The resulting wind turbine layout is shown in Figure 4-1 for the Chokecherry WDA and Figure 4-2 for the Sierra Madre WDA. Details on the layout are provided in Appendix B.

To meet PCW's objective of constructing the CCSM Project as rapidly as possible on an optimized schedule, the elements associated with the Phase I Wind Turbine Development were design for efficient construction. The Phase I Wind Turbine Development design includes features such as crane paths, circular traffic patterns, and distributed and flexible laydown yards to optimize the construction schedule. In addition, PCW has designed each element of the Phase I Wind Turbine Development to balance environmental impacts by minimizing ground disturbance and avoiding impacts to sensitive environmental resources where practicable. The elements of the Phase I Wind Turbine Development, including the wind turbines, are described in Section 4.3.

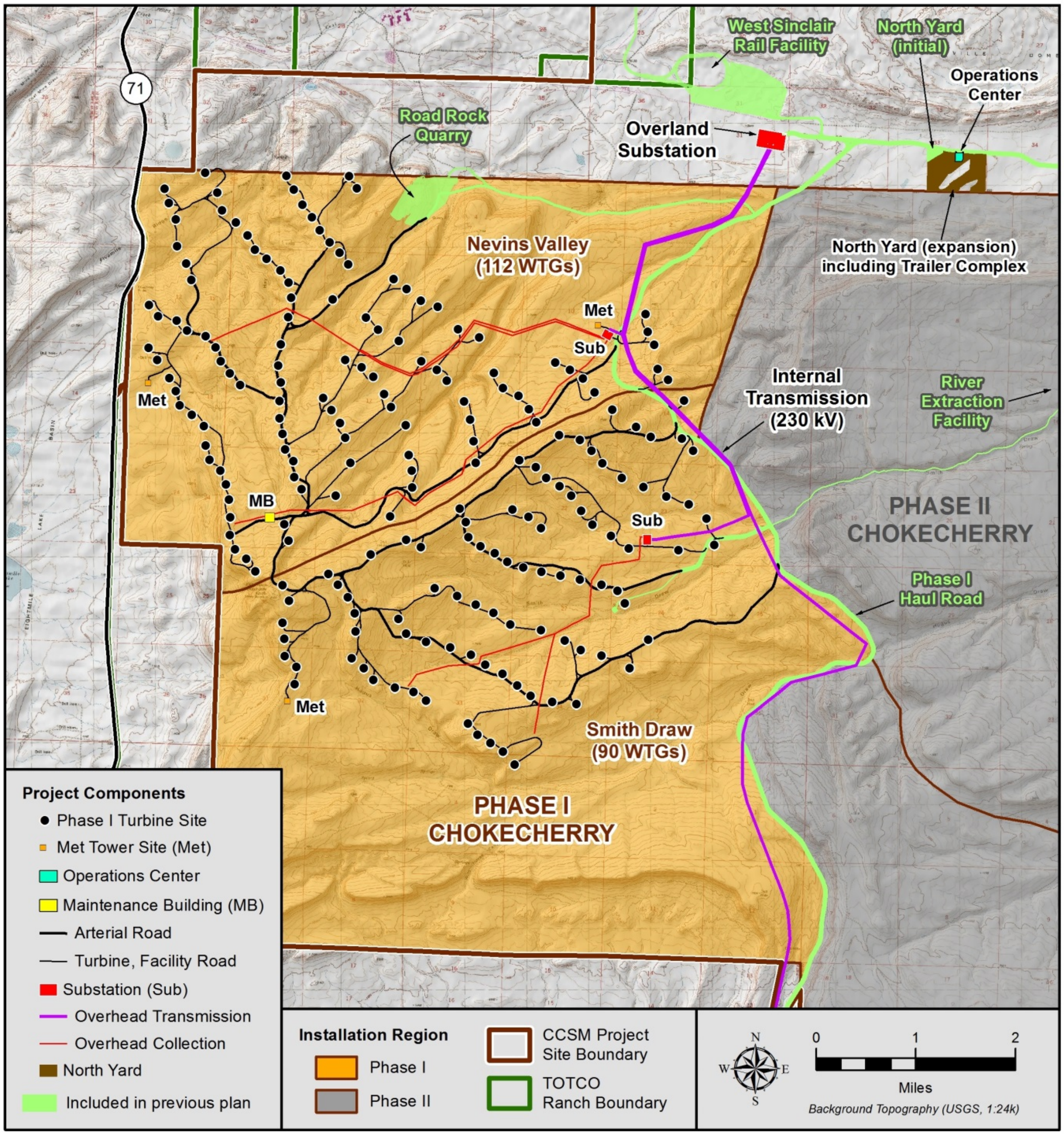

Figure 4-1. Phase I Wind Turbine Development Layout – Chokecherry WDA

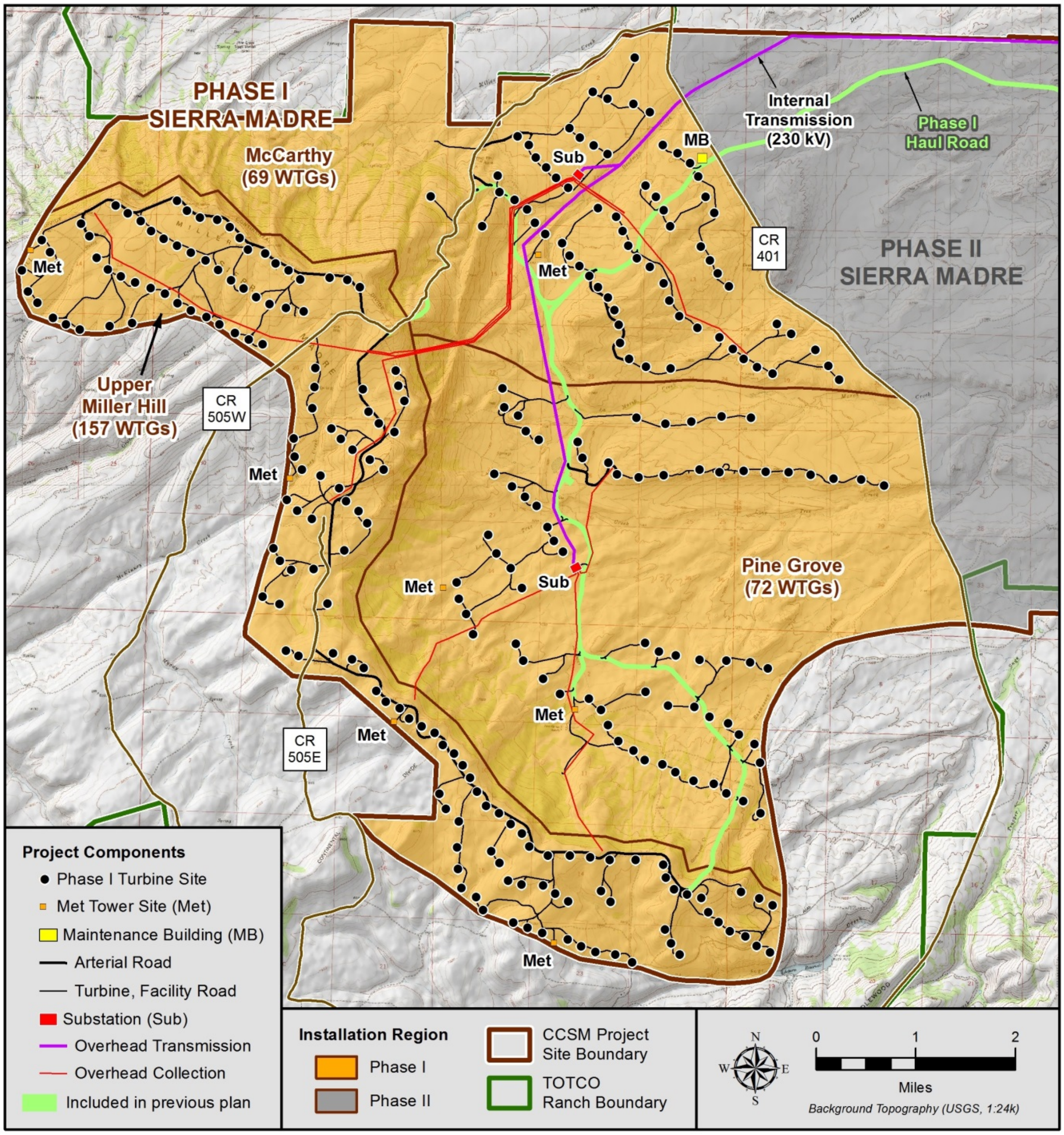

Figure 4-2. Phase I Wind Turbine Development Layout – Sierra Madre WDA

4.2 Design Development

The Phase I Wind Turbine Development layout was developed in coordination with BLM and USFWS using detailed site-specific information. The layout was designed to meet the CCSM Project goals and objectives while complying with the ROD and guidance from the USFWS to avoid and minimize environmental impacts. The ROD considered and adopted numerous environmental constraints, applicant committed measures, and mitigation measures to avoid or minimize environmental impacts (BLM 2012b, p. 3-13). In addition, the ECP Guidance and the 2012 Land-Based Wind Energy Guidelines (WEG) (collectively USFWS Guidance) recommend extensive measures including collecting site-specific eagle survey data and the application of avoidance and minimization measures (USFWS 2012; USFWS 2013a). In compliance with the ROD and the USFWS Guidance, PCW collected site-specific data and used the rigorous micro-siting process described in detail below to design the Phase I Wind Turbine Development.

As an initial matter, PCW's ability to site turbines was constrained to the WDAs as designated in the ROD. Within these designated WDAs, PCW used a four-step iterative process to micro-site the turbines for the Phase I Wind Turbine Development layout:

1. Gather technical data;
2. Complete field review;
3. Gather resource data; and
4. Incorporate agency input.

4.2.1 Technical Data Collection

The first step in designing the Phase I Wind Turbine Development is the collection of technical data. Technical data collection for the CCSM Project Site has been ongoing since 2007. Technical data collection included: (1) meteorological data to measure wind resources, (2) topographic surveys to develop 1-foot contours, (3) 1-foot resolution orthophotography, (4) utility surveys to identify existing utility locations, and (5) geotechnical investigations to identify civil engineering design options. Through desktop analysis of available technical data, PCW developed a preliminary layout for the Phase I Wind Turbine Development.

4.2.1.1 Meteorological Data

Since 2007 PCW has been measuring the wind resource across the CCSM Project Site. To date, PCW has installed 38 meteorological towers and has used a sonic detection and ranging (SODAR) unit to record wind data in various locations across the site. The result of this wind resource monitoring program, developed and managed by PCW's contractor AWS Truepower, is a wind map from which PCW can estimate potential wind turbine performance at any location on the CCSM Project Site with a high degree of accuracy.

4.2.1.2 Topographic Data, Photography, and Utility Survey

PCW conducted an aerial survey of the CCSM Project Site in July and August 2010, which included the acquisition of orthophotography and light detection and ranging (LiDAR) elevation data. This survey provided data sufficient to develop 1-foot contours of the CCSM Project Site's topography, as well as 1-foot resolution aerial photography. In addition, PCW has surveyed the underground and overhead utilities throughout the Ranch and along the northern and western boundaries of the CCSM Project Site. PCW has also worked with the City of Rawlins and Town of Sinclair to evaluate their utility infrastructure within and near the CCSM Project Site.

4.2.1.3 Geotechnical Investigations

PCW has performed several geotechnical investigations to provide baseline data for the CCSM Project Site, including the Phase I Wind Turbine Development Site. These investigations have provided sufficient data to characterize the CCSM Project Site for purposes of identifying the expected geologic conditions and the civil engineering design options available for the CCSM Project. However, these investigations will also be augmented by additional analysis of each turbine site to confirm the foundation design prior to construction. The confirmation boring will be completed once the turbine locations are permitted and the models are selected, generally after commencement of construction of the CCSM Project infrastructure.

4.2.2 Field Review

Once the preliminary layout was complete, PCW mobilized a team of civil engineers and construction specialists to field review the layout and microsite each potential turbine location (Figure 4-3). During the micro-siting process, the field review team physically visited each location and compared the design conditions with the actual field conditions. These field reviews resulted in recommendations for improving the preliminary layout and engineering design to minimize disturbance and create a more efficient design. The field review team's recommendations were evaluated against the design criteria and environmental constraints and the Phase I Wind Turbine Development layout was modified as appropriate.

Figure 4-3. CCSM Field Team

4.2.3 Resource Data Collection

PCW completed extensive surveys for cultural resources and natural resources for the CCSM Project. As required by the ROD and BLM, PCW collected detailed site-specific data for the Phase I Wind Turbine Development. These data are in addition to the data previously collected to support the EIS and to address other agency requirements and recommendations. Surveys were completed across over 27,000 acres to micro-site Phase I of the CCSM Project. Surveys conducted include:

- Wildlife surveys for Wyoming pocket gopher, pygmy rabbit, white-tailed prairie dog, and other BLM sensitive wildlife species, as specified in Appendix G of the ROD.
- Greater sage-grouse surveys
- Rare plant and rare plant habitat surveys
- Noxious and invasive weed surveys
- Erosion potential characterization
- Class III cultural resource surveys
- Paleontological resource surveys
- Wetland delineations
- Soil and vegetation surveys

PCW also collected data for purposes of evaluating use by eagles and non-eagle raptors as well as other avian species and bats. These data were collected in accordance with the recommendations made in the USFWS Guidance. This information was used by USFWS to recommend additional avoidance and minimization measures for the Phase I Wind Turbine Development layout specific to eagles. The data collection and avoidance and minimization process for eagles is described in detail in the ECP. Surveys completed for avian species and bats include:

- Eagle and non-eagle raptor nest surveys and productivity monitoring across approximately 460,000 acres
- Eagle and raptor use surveys including approximately 5,000 hours of survey across more than 171,000 acres associated with 104 survey locations
- Migratory bird surveys at 44 locations
- Breeding bird density, diversity, and habitat surveys completed at 16 locations
- Avian and bat radar surveys across more than 280,000 acres
- Detailed eagle prey base surveys across the CCSM Project Site including waterbird surveys, white-tailed prairie dog surveys, and sage-grouse lek surveys and monitoring
- Acoustic monitoring for bats at 11 locations
-

Based on the resource survey data, PCW identified environmental constraints and areas where avoidance and minimization measures could be applied. As opportunities for design modification were identified, they were evaluated against the design criteria and environmental constraints, reviewed by the field review team, re-surveyed for cultural and natural resources, and implemented where feasible.

4.2.4 Agency Input

Following resource data collection, PCW provided the relevant cultural and natural resource survey data to BLM and USFWS. Using the site-specific survey data, BLM and USFWS identified additional modifications to the Phase I Wind Turbine Development layout to avoid and minimize environmental impacts and comply with the ROD. As described above, these recommendations were then evaluated against the design criteria and environmental constraints, reviewed by the field review team, re-surveyed for cultural and natural resources and implemented where feasible. Within the WDAs identified in BLM's Selected Alternative, the layout for the Phase I Wind Turbine Development was adjusted numerous times during micro-siting to avoid and minimize environmental impacts and to incorporate input from BLM and USFWS.

As contemplated in the ROD, PCW worked cooperatively with BLM and USFWS to address micro-siting issues and develop a coordinated layout for the Phase I Wind Turbine Development (BLM 2012b, Appendix C, p. C-20). PCW provided weekly and monthly survey reports to BLM throughout the 2013 field season for the cultural and natural resource surveys and attended a number of on-site visits with BLM RFO. In addition, PCW worked jointly with BLM RFO staff over the 2014 field season to collect additional soil and vegetation data across the Phase I Wind Turbine Development. PCW also coordinated extensively with USFWS over that last 5 years to establish survey protocols and to identify and apply eagle avoidance and minimization measures, as detailed in the ECP. Thus, the resulting Phase I Wind Turbine Development layout presented in Section 4.1 and detailed in Appendix B is the culmination of PCW's extensive micro-siting effort, years of coordination between PCW, BLM, USFWS, and other agencies, and PCW's compliance with the ROD and USFWS Guidance.

4.3 Phase I Wind Turbine Development Elements

The Phase I Wind Turbine Development consists of the first half of the CCSM Project's wind turbines and their supporting elements (also referred to as project facilities and components). Each element of the Phase I Wind Turbine Development is summarized in Table 4.2 and is further described below.

Table 4.2. Phase I Wind Turbine Development Elements

Element	Purpose
Roads	Access to wind turbines and other facilities.
Wind Turbine Sites	Locations for wind turbine installations.
Foundations	Structural support for wind turbines and other facilities.
Wind Turbines	Power generation equipment to convert wind into electrical power.
Collection System	Electrical system that collects energy generated from each turbine and transmits it to the collection substations.
Substations	Collection: Gathering point for wind turbine generation. Interconnection: CCSM Project connection to electrical grid.
Internal Transmission System	Electrical system that transmits energy from collection substations to interconnection substation.
Buildings	Operations Center: primary office building for CCSM Project Maintenance Buildings: shop and storage areas to support turbine maintenance.
Meteorological Towers	Monitor wind conditions for performance forecasting and monitoring.
Utilities	Water, wastewater, and distribution power to support CCSM Project elements.
Temporary Features	Facilities temporarily needed during construction, including laydown yards, crane assembly areas, crane paths, and on-site accommodations (construction camp and RV park).

4.3.1 Roads

The Phase I Wind Turbine Development roads provide access from the Phase I Haul Road to the wind turbines, overhead collection and transmission line structures, meteorological towers, and other elements. As described in CCSM Project Road Design Manual (Appendix C), the CCSM Project has five road classes to accommodate different levels and types of traffic. PCW analyzed the anticipated traffic requirements for each road to identify the appropriate road class. The Phase I Turbine Wind Development roads include arterial roads, turbine and facility roads, structure roads, and unimproved access routes. Where possible, PCW has located buildings and substations along the haul road or arterial roads to reduce the total length of roads required. In addition, PCW has identified locations where unimproved access routes are appropriate to further minimize disturbance. The Phase I Wind Turbine Development roads are shown in Figure 4-1 and Figure 4-2. The design elements for each road class are described in the CCSM Project Road Design Manual (Appendix C). The Issued for Permit Plans for the Phase I Wind Turbine Development identify each road class within the Phase I Wind Turbine Development Site (Appendix B).

4.3.1.1 Design

The design of the Phase I Wind Turbine Development roads takes into account the design requirements identified in the CCSM Project Road Design Manual (Appendix C), including vendor requirements for transporting wind turbine components, as well as local geologic and soil conditions and the varying levels of expected use throughout the CCSM Project's construction, operation, maintenance, and decommissioning. Construction requirements use soil condition assumptions derived from the site-specific conditions found during geotechnical testing (Fugro 2013). During construction, site-specific soil properties will be evaluated to determine the bearing capacity of the soil and verify any required subgrade stabilization measures. Stabilization measures are described in the CCSM Project Road Design Manual (Appendix C). The aggregate base thickness for the Phase I Wind Turbine Development roads will vary between 4 and 16 inches depending on soil conditions. PCW expects that the construction team may encounter variations in soil characteristics that will require field adjustments. If necessary, additional subgrade stabilization measures may be employed including additional aggregate base, geotextile fabrics, or geo grid.

4.3.1.2 Hydrology

The Phase I Wind Turbine Development road alignments cross a number of drainages. The alignments were chosen to minimize the number of crossings to the extent practicable. Where crossings were necessary, crossing locations were chosen to minimize the disturbance required and to reduce drainage crossings at locations near turbine sites. As described in the road design manual (Appendix C), drainage crossings for turbine and facility roads allow for use of at-grade low water crossings where appropriate. At-grade low water crossings will be used for crossing minor drainages to reduce the width of disturbance and reduce the potential for erosion at the locations identified in Appendix B. Typical drainage crossing designs are shown in Appendix C and in the Issued for Permit Plans for the Phase I Wind Turbine Development Site in Appendix B.

4.3.2 Wind Turbine Sites

Each wind turbine site includes three areas: initial disturbance, long-term disturbance, and activity areas (Figure 4-4). The initial disturbance is the area around the turbine where ground disturbance is required to install the wind turbine, including the turbine's foundation and electrical connections. Following installation of the wind turbine, portions of the initial disturbance will be reclaimed such that a much smaller graveled area remains at each site (the long-term disturbance) to provide access to the turbine during operations and maintenance. Activity areas at a wind turbine site are areas that will not be cleared or graded, but where workforce and vehicles may need access to support wind turbine erection. In these areas vehicles, e.g., pickup trucks, rough-terrain cranes, and all-terrain vehicles (ATVs), and crews on foot will use designated routes to support turbine erection. In activity areas, thick vegetation higher than 1 foot may be trimmed to allow for safe vehicle access and minimize fire potential.

The initial disturbance area at each wind turbine site provides for:

- Foundation construction, including component staging and concrete placement
- Separated stockpiles of topsoil and subsoil from site grading and foundation excavation
- Soil preparation for backfill, if needed
- Electrical line trenching and padmount component placement
- Turbine component storage prior to erection
- Turn-around area for delivery vehicles (if needed)
- Pads for main erection crane, and routes in and out for cranes
- Operation areas for rough-terrain and other smaller support cranes used in component offloading, rotor assembly, and turbine erection
- Hub location for turbine rotor assembly

The initial disturbance area at wind turbine site will have a grade of no more than 5% and have sufficient soil properties to support the turbine assembly activities. If the native terrain is less than 5% grade and the construction contractor determines the native soil conditions are sufficient for turbine assembly, then the vegetation will be lowered or cleared as needed, but the topsoil will remain in place to minimize disturbance. However, if native soil conditions do not meet construction requirements or if the terrain exceeds a 5% slope, the topsoil will be stripped and stored per the requirements of the reclamation plan (Appendix L), the site will be graded and compacted if needed, and where necessary, aggregate will be placed within the temporary disturbance area. Where grading is necessary, the site will be graded to tie the access road into the native terrain at a maximum 4:1 slope unless otherwise specified in the site plan. For purposes of planning and permitting, it is assumed that each wind turbine site will be cleared and graded.

While PCW used a template as a basis for the design of each wind turbine site, each site was field reviewed for terrain and site access requirements. Where required, the layout of the wind turbine site was optimized. In some cases where site access was favorable and the existing terrain would necessitate a large temporary disturbance area, PCW designed the wind turbine site to require the turbine components be erected directly from the delivery vehicles, using a Just-in-Time (JIT) approach rather than staging the components at the site. While these JIT sites have a smaller overall disturbance area, they must still be large enough to allow for turbine rotor assembly on the ground and they require much more logistical coordination, slower overall construction, and increase the risk of schedule delay. As such, PCW has carefully chosen which wind turbine sites will use the JIT approach to maintain efficient and cost-effective construction. Example layouts for JIT wind turbine sites are shown in Figure 4-5.

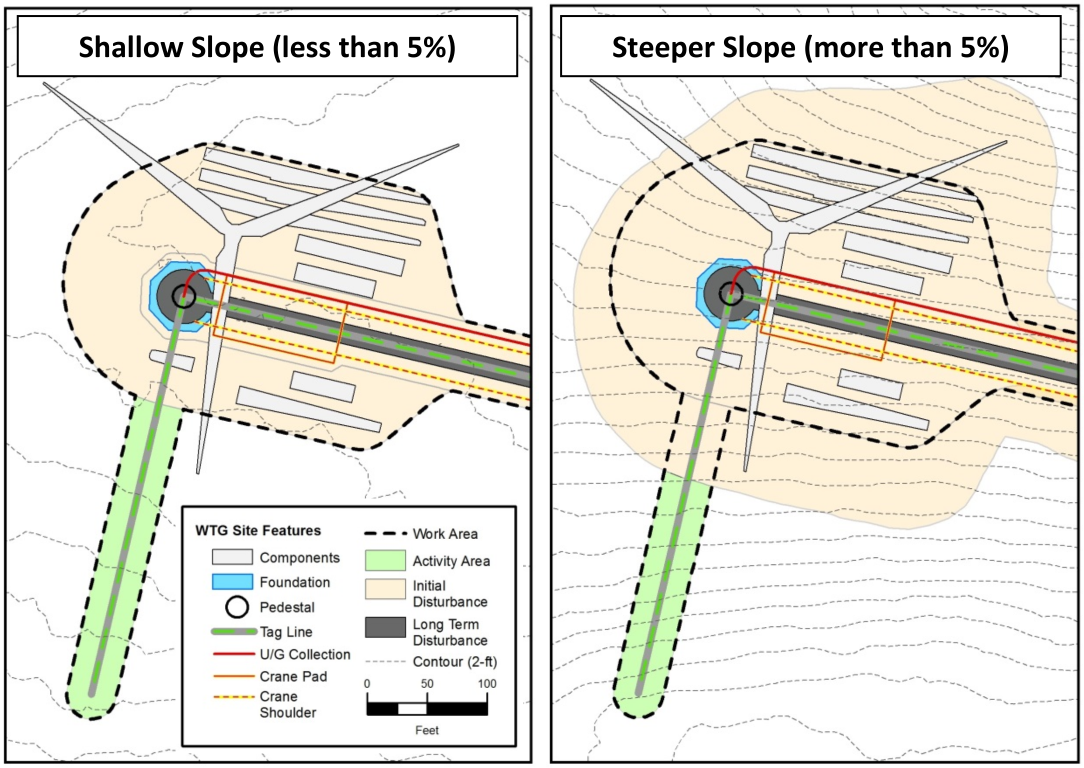

Figure 4-4. Example Wind Turbine Site

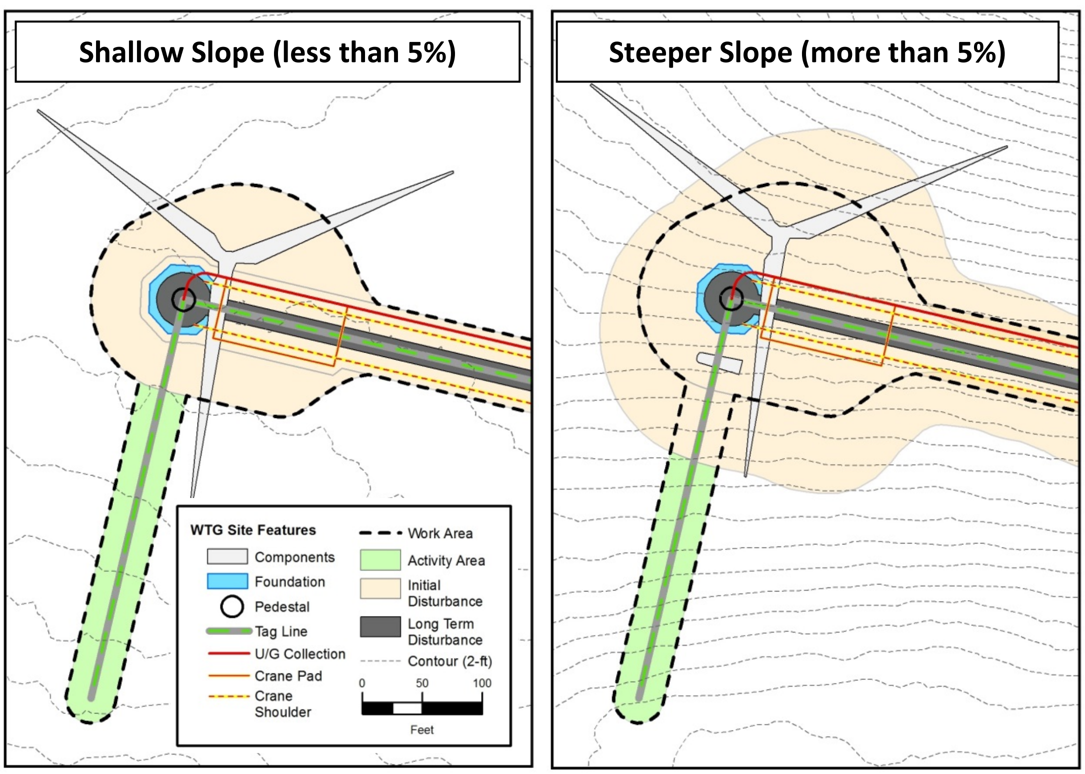

Figure 4-5. Example JIT Wind Turbine Site

4.3.3 Foundations

The majority of the Phase I Wind Turbine Development elements require foundations for support. The types of foundations used in the Phase I Wind Turbine Development are described below.

4.3.3.1 Wind Turbine Foundations

The bottom section of a wind turbine tower is connected to a foundation comprised of concrete and steel. The design requirements and approaches for wind turbine foundations are discussed below. For those instances where site-specific conditions deviate from the design parameters, the methods for design modification are also described.

4.3.3.1.1 Design Requirements

A wind turbine foundation must securely hold the wind turbine in place, account for local soil and weather conditions, meet applicable codes, and be cost effective. The following sections describe the primary requirements applied to the wind turbine foundation design for the CCSM Project. While the typical wind turbine foundation design parameters are described below, ultimately the requirements and dimensions of each wind turbine foundation will be set by a licensed professional engineer.

4.3.3.1.1.1 Standards and Codes

Each wind turbine foundation design must meet requirements set by wind energy industry standards and applicable building codes. The following standards are typically used for the design of a wind turbine foundation:

- American Wind Energy Association, American Society of Civil Engineers, ASCE/AWEA RP2011, Recommended Practice for Compliance of Large Land-Based Wind Turbine Support Structures, December 2011.
- International Electrotechnical Commission, Wind Turbine Generator Systems – Part 1: Safety Requirements, 3rd edition, 2005.
- Germanischer Lloyd, GL Wind Guidelines 1.1, Edition 2012.
- Det Norske Veritas Copenhagen and Wind Energy Department, Riso National Laboratory, Guidelines for Design of Wind Turbines, 2nd Edition, 2002.
- Det Norske Veritas, Offshore Concrete Structures, Offshore Standard DNV-OS-C502, April 2010.
- International Code Council Inc., International Building Code, 2009.
- American Society of Civil Engineers, ASCE 7-10 Minimum Design Loads for Buildings and Other Structures, 2010.
- American Concrete Institute, ACI 318-11, Building Code Requirements for Structural Concrete, 2011.
- American Institute of Steel Construction Inc., Steel Construction Manual, 13th Edition, 2005.
- American Concrete Institute, ACI 336R.4-XX, Guide for Analysis of Spread Footings by the Strength Design Method, Draft 2008.
- Fahey M., Soil stiffness values for foundation settlement analysis, Proc. 2nd Int. Conf. on Pre-Failure Deformation Characteristics of Geomaterials, Torino, Vol. 2, 1325-1332, 1999.
- Concrete International, Safe Shear Design of Large, Wide Beams, January 2004, Vol. 26 No. 1, pages 67-78.
- Potyondy, J.G., Skin Friction Between Various Soils and Construction Materials, Geotechnique, December 1961.

4.3.3.1.1.2 Manufacturer

Each wind turbine manufacturer specifies foundation loading and design requirements for each wind turbine model they manufacture. Loads include extreme loads due to wind or operation, normal operating loads, and fatigue loads. Design requirements include items like required minimum foundation stiffness, maximum allowable differential settlement, and tower connection details. PCW has not yet selected a specific turbine model for the CCSM Project. To develop the primary wind turbine foundation design for the project, PCW reviewed the requirements of several candidate models and developed a set of design requirements. These requirements are summarized in Table 4.3.

Table 4.3. Wind Turbine Foundation Design Requirements

Design Element	Requirement
Characteristic Normal Extreme Moment (apply a 1.35 load factor)	81,900 kN-m
Characteristic Abnormal Extreme Moment (apply a 1.1 load factor)	90,700 kN-m
Normal Operating Moment	50,400 kN-m
Fatigue Loads	Fatigue Spectrum in accordance with IEC 61400-1
Minimum Foundation Rotational Stiffness	1,500 MN-m/degree
Minimum Foundation Lateral Stiffness	500 MN-m
Maximum Differential Settlement	0.25 degrees of rotation
Tower Connection Requirements	200 x 1.375 inch diameter bolts with a yield strength of 120 ksi and tensile strength of 150 ksi

4.3.3.1.1.3 Geotechnical

PCW has performed initial geotechnical investigations on the CCSM Project Site (Terracon 2012; Fugro 2013). From these investigations, PCW has determined the range of geotechnical conditions that will likely exist at the wind turbine sites, including:

- Soil type
- Soil density
- Soil strength
- Soil compressibility
- Soil stiffness
- Soil water content
- Site seismicity
- Slope stability
- Flooding potential
- Scour potential

The Phase I Wind Turbine Development wind turbine foundation design is based upon the results of this geotechnical investigation. Prior to construction, PCW will verify the geotechnical conditions at each turbine site as required by the foundation design engineer. This verification typically involves soil borings, test pits or in-situ testing to a depth of influence of the foundation, which is typically the width of the foundation plus its embedment beneath the surface. Collected soil samples are subjected to laboratory testing to determine the physical and mechanical (strength, stiffness, and compressibility) characteristics of the soil encountered. If geotechnical conditions are outside the design parameters, PCW will use the alternative foundation design approaches discussed in Section 4.3.3.1.3. The geotechnical requirements for the wind turbine foundations are based on the soil properties determined by geotechnical investigation and testing. The geotechnical requirements for the CCSM Project include the following:

- **Soil bearing resistance.** The bearing pressures exerted by the foundation on the soil must not exceed the allowable bearing resistance of the soil. Typically, for normal operational loads, the soil ultimate bearing strength is divided by a factor of safety of 3 to obtain the allowable bearing pressure, and the foundation pressures cannot exceed this. For extreme turbine loads a factor of safety of 2.25 is used. For abnormal extreme loads and combinations of earthquake load and operation a factor of safety of 1.8 is used.
- **Soil compressibility, differential settlement, and total settlement.** The compressibility of soil determines design parameters for immediate and long term settlement of the foundation. Typically, the differential settlement of the foundation is limited to 0.17 degrees or 3 millimeters per meter. The type of wind turbine currently being planned for generally allows for 0.25 degrees.
- **Foundation stiffness.** The required stiffness of the foundation is specified by the manufacturer in the foundation load document. All manufacturers stipulate a minimum required rotational stiffness of the foundation and some manufacturers specify an additional minimum horizontal stiffness. The soil properties are used to calculate the foundation stiffness to determine compliance with the manufacturer's requirements.

4.3.3.1.1.4 Structural

In addition to the requirements discussed above, general structural engineering requirements must also be considered in the foundation design. These requirements include:

- **Global stability of the foundation against overturning and sliding.** The minimum factor of safety against overturning and sliding is 1.5. The dead weight of the foundation, the soil, the tower and turbine and the width of the foundation resist overturning. Typically, other design requirements dictate the size of the foundation and the factor of safety against overturning is usually above 2.0. The horizontal load is small relative to the overturning moment and there is large horizontal resistance due to friction at the base of the foundation with soil and passive lateral resistance of the soil, resulting in typically a large factor of safety against sliding in excess of 10.
- **Connection of the tower to the foundation.** The connection of the tower to the foundation consists of the tower base flange with bolt holes, connected to anchor bolts and embedment plate ring embedded in the foundation. The connection is designed in accordance with the requirements of ACI 318 and ASCE Steel Construction Manual. A pre-tension force is selected to prevent fatigue of the bolts.
- **Reinforced concrete ultimate strength design.** Reinforced concrete ultimate strength design of the foundation is done in accordance with guidelines developed by the American Society of Civil Engineers and the American Wind Energy Association which relate to standards developed by the International Electro-Technical Commission, the American Concrete Institute, and the American Institute of Steel Construction. The basic premise of ultimate strength design is that the probability of the material failing is low given the probability of a load occurring is low. The design procedure establishes a level of design reliability.
- **Reinforced concrete fatigue design.** There are no specific United States standards that address reinforced concrete fatigue design; any guidelines that have been developed in the United States were developed decades ago and are limited in scope. However, fatigue standards developed in Europe for offshore structures have been implemented in the last five years and are appropriate in that the design equations can consider the large number of fatigue cycles and large range of loads exerted by the wind turbine. Fatigue design checks for tension in the reinforcing steel, and compression and shear in the concrete will be performed.

4.3.3.1.1.5 Construction

The design of the wind turbine foundations must consider what construction materials can be reasonably procured, including cement, coarse and fine aggregates for concrete, reinforcing steel, and anchor bolts. Construction requirements address the following:

- **Excavation, subgrade preparation, backfilling, and grading requirements.** The excavation must allow for construction of the foundation while meeting safety requirements for personnel. Geotechnical engineering requirements may require that the subgrade be surface-compacted, proof-rolled, and tested. Backfill placed over the foundation must meet both geotechnical and structural requirements. Grading of the site must be performed to prevent ponding of water over the foundation.
- **Serviceability and durability requirements, such as freeze-thaw resistance, chemical resistance, and crack control.** For durability, high strength concrete with a compressive strength greater than 5,000 pounds per square inch (psi) is specified. For concrete exposed to freeze-thaw cycles, air entrained concrete is specified. If naturally occurring sulfates are present in the soil or if the aggregates used in the concrete are reactive, additional materials such as fly ash and chemicals admixtures may be used to improve concrete resistance and mitigate long term deterioration. Crack control of concrete is achieved by specifying performance requirements for concrete curing and protection, by using curing membranes applied to the surface, wetting of the surfaces, and covering surface with tarps to reduce sun and wind exposure.
- **Constructability requirements including mass concrete, concrete curing and quality assurance/quality procedures.** Mass concrete is defined as any concrete placement which could have the potential to create enough heat of hydration to cause strength and cracking problems with the concrete. The construction specifications require the contractor to a submit a plan which mitigates the negative consequences of heat generation primarily by using concrete mix designs which generate less heat, temperature control of the concrete materials during mixing, and protection of the concrete from air temperature while curing. ACI 318 stipulates requirements for the maximum temperature of concrete and maximum differential temperature in concrete structures.

Quality assurance procedures are stipulated by the construction specifications that verify the following to determine if the foundation construction conforms to the structural design requirements:

- Subgrade strength
- Concrete mix design
- Concrete strength
- Reinforcing steel yield strength
- Quality of cement, coarse aggregates and fine aggregates
- Anchor bolt size and length, nuts and washers
- Anchor bolt yield strength
- Anchor bolt pre-tension
- Embedment plate dimensions
- Embedment plate yield strength
- Backfill density
- Base flange grout strength.

4.3.3.1.2 Primary Wind Turbine Foundation Design

Based upon the design requirements outlined above, PCW developed the primary design for the wind turbine foundation. The primary wind turbine foundation design for the CCSM Project is the mat foundation, also referred to as spread-footing, gravity, or inverted-T. Mat foundations are the most widely used design for wind turbine foundations due to their versatility. Mat foundations were chosen for the CCSM Project because they allow for a wide range of soil conditions and they are simple to construct, requiring only shallow excavations. Due to the versatility of mat foundations, mat foundations will be suitable for most wind turbine sites in the Phase I Wind Turbine Development, and will also provide for economies of scale and efficient construction. Figure 4-6 shows a constructed wind turbine mat foundation prior to backfill, and the completed wind turbine installation on top of the tower.

Figure 4-6. Wind Turbine Foundation Examples

Figure 4-7 shows an overview of the mat foundation design. A mat foundation consists of two general components: the footing, and the pedestal. The footing is an octagonal element at the bottom of the foundation that includes most of the foundation's concrete and steel. Steel rebar cages that tie to the anchor bolts provide a significant portion of the foundation's strength. Concrete poured within and around the rebar cage provides the necessary weight for the foundation. The footing, when placed upon firm ground and backfilled over with excavated soil, has sufficient weight and overturning resistance to resist the forces acting upon the wind turbine. The second component of the mat foundation, the pedestal, is the interface between the footing and the wind turbine tower. The anchor bolts feed up through the footing and connect to the flange at the bottom of the turbine's base tower section. Wind turbines are further secured to the foundation with grout placed under the tower base.

As described above, a mat foundation design was chosen as the primary foundation because a single design can accommodate a wide range of site and soil conditions. The dimensions of the mat foundation design for the CCSM Project are provided in Table 4.4. However, slight variations in size are still possible to account for localized variations in soil bearing resistance, soil settlement behavior, and water content (groundwater table and buoyancy). Based upon PCW's final wind turbine design selection and localized soil conditions, some portions of the mat foundation design dimensions may be adjusted. The final dimensions are expected to be within the ranges presented in Table 4.4, and therefore should have no impact on the CCSM Project footprint or material requirements. PCW anticipates that, on average, the concrete volumes required for the wind turbine foundations will be less than 600 cy per foundation. Drawings of the primary foundation design are provided as part of the Phase I Wind Turbine Development Issued for Permit Plans in Appendix B.

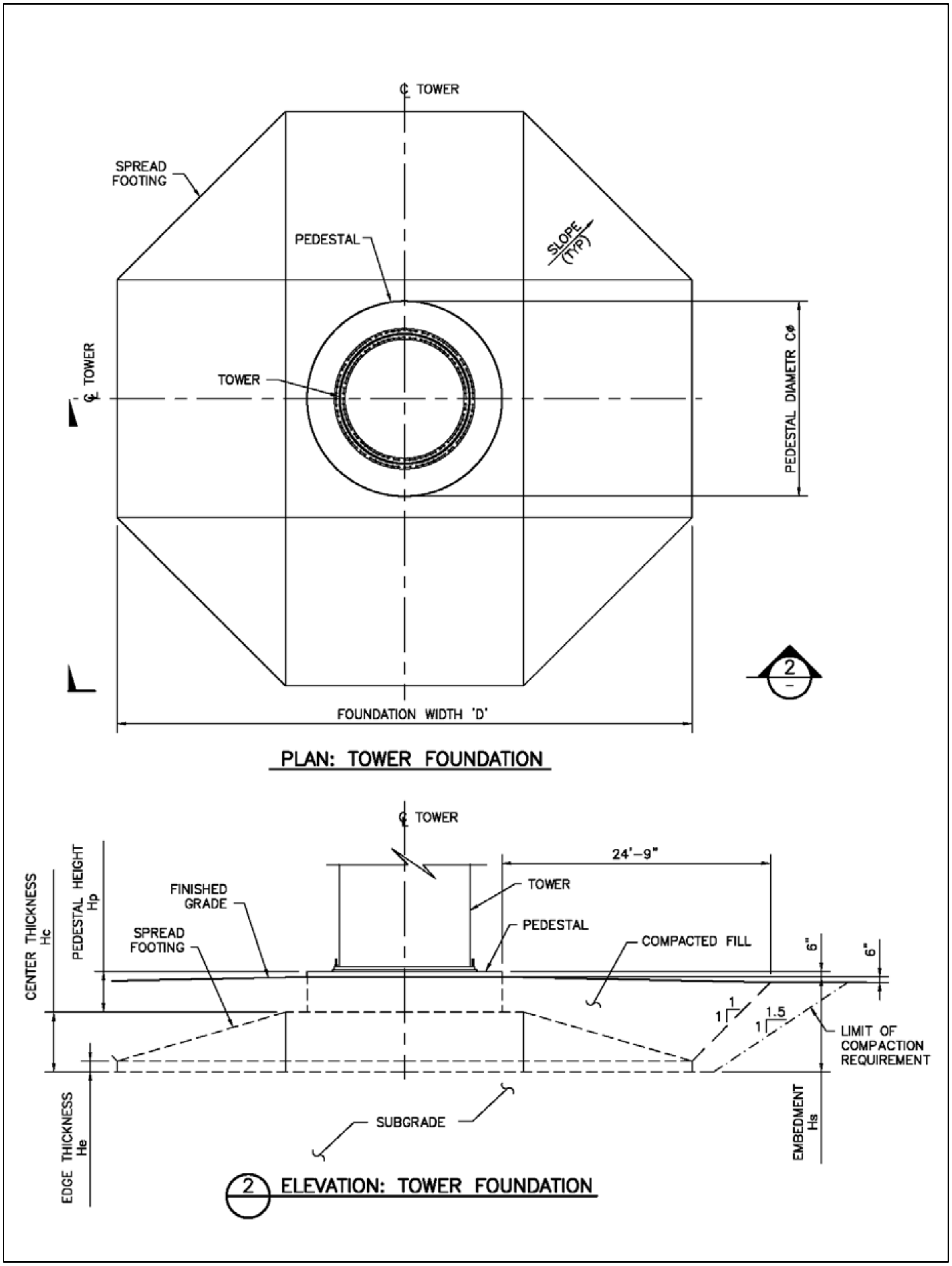

Figure 4-7. Wind Turbine Foundation Diagram

Table 4.4. Wind Turbine Foundation Dimensions

Foundation Element	Variable	Dimensions		
		Minimum	Primary Design	Maximum
Footing				
Width	D	60 ft	63 ft	65 ft
Embedment	Hs	8 ft	9.5 ft	12 ft
Edge Thickness	He	1.5 ft	2.0 ft	3.0 ft
Center Thickness	Hc	5 ft	6 ft	7 ft
Pedestal				
Diameter	C	18 ft	19 ft	20 ft
Height	Hp	3 ft	4 ft	5 ft
Material Quantities				
Concrete		525 cy	563 cy	650 cy
Reinforcing Steel		50 tons	52 tons	60 tons

Notes: Minimum and maximum dimensions are the expected range for 3MW wind turbines and soil conditions, and represent envelope for design. Primary Design dimensions are for designs included in Appendix B, reflecting anticipated dimensions for the CCSM Project.

While PCW anticipates that most site and turbine design variations can be accounted for using mat foundations within the dimension range presented in Table 4-4, if soil conditions deviate significantly from the anticipated conditions PCW will use an alternative foundation design as described in Section 4.3.3.1.3. Regardless of which foundation solution is used, the ground disturbance will remain within the wind turbine site's disturbance area.

4.3.3.1.3 Alternate Wind Turbine Foundation Designs

Based on geotechnical investigations performed thus far, PCW does not anticipate alternative foundation designs will be required. However, if unforeseen soil conditions are found, PCW has developed the options described in this section to address them. For all of the design options described below, the ground disturbance footprint remains within the wind turbine site. Hence, there is no significant change to the impacts caused by the foundation construction.

The most common and economical approach to address unanticipated soil conditions is soil improvement. For the Phase I Wind Turbine Development, PCW evaluated several soil improvement methods as potential solutions for unanticipated soil conditions. Table 4.5 provides a soil improvement solution matrix for any soil conditions outside design tolerances.

Table 4.5. Wind Turbine Foundation Soil Improvement Solution Matrix

Soil Improvement Method	Shallow Poor Soils less than 5 feet deep below surface	Shallow Poor Soils less than 30 feet deep below surface	Non-Cohesive Collapsible Soils less than 30 feet deep below surface	Poor Soils Greater than 30 feet deep below surface	Karst Features Greater than 30 feet deep below surface
Mat Foundation with Subcut Soil Correction	●				
Mat Foundation with Stone Columns		●			
Mat Foundation with Dynamic Compaction			●		
Pile Foundations				●	●

Subcut Soil Correction. When a relatively thin layer of soil (often 5 feet or less) beneath the foundation excavation is found to have insufficient bearing capacity or settlement behavior, the soil can be removed and re-compacted, or replaced with imported soil meeting design characteristics. To correct the soil deficiency, the contractor will "sub-cut" the site, or remove soil down to a depth where soil conditions meet design requirements. Imported soil, often called engineered fill, will be brought from a nearby excavation site that has excess fill or from the Road Rock Quarry and placed to meet moisture and compaction requirements. Once the fill is compacted, the foundation is then built on top of the fill. Figure 4-8 shows a typical diagram for the "sub-cut" or over-excavation process, with the exact dimensions of the excavation and fill determined by individual site conditions.

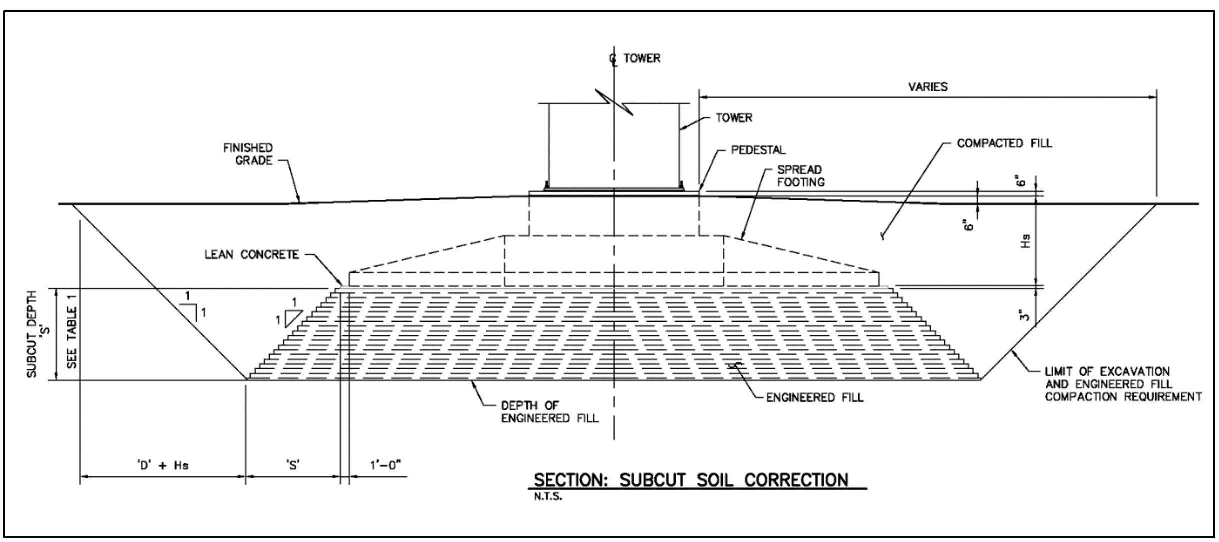

Figure 4-8. Sub-cut Soil Correction Design

Stone Columns. When poor soil conditions are found below depths where sub-cut soil correction is economical and technically feasible, soil stabilization is commonly used. The most common and economic method to stabilize the soils under a wind turbine foundation is often to construct stone columns. Starting at the existing grade, open shafts are drilled to a specified design depth, but generally no greater than 30 feet due to the limitations of the equipment. Stone is next placed into the shaft and a vibratory shaft compactor compacts and densifies the stone in the shaft. The stone pushes out into the sidewalls of the shaft and compacts the soil around the shafts to achieve foundation design conditions. The site is then excavated and the mat foundation built on top of the columns. Figure 4-9 shows the typical installation pattern for stone columns under a mat foundation, and Figure 4-10 shows the typical installation technique for the stone columns.

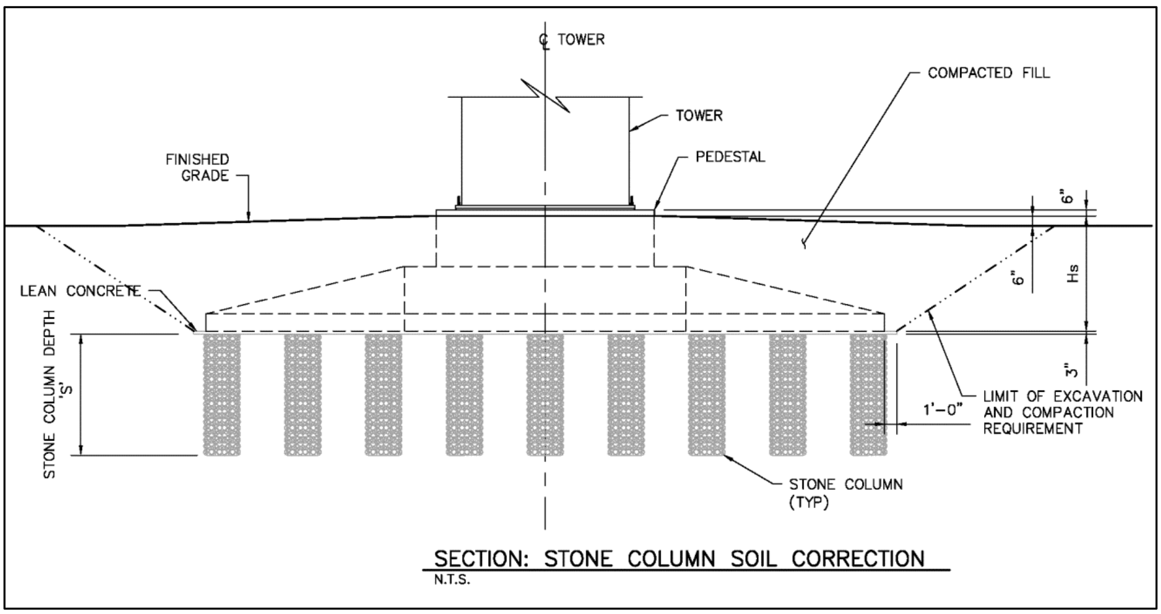

Figure 4-9. Stone Columns Design

Figure 4-10. Stone Column Installation

Dynamic Compaction. For collapsible soils that do not extend beyond 30 feet in depth, dynamic compaction is performed to break down the meta-stable soil cohesion which is present and densify the soils. This method uses a crane dropping a large weight over a grid pattern covering the dimensions of the foundation. Earthwork equipment levels the compacted area after completion of the compacted grid pattern. Once the required number of compaction passes is performed and the required soil compaction is achieved, excavation for the foundation is completed, and the foundation is constructed. Figure 4-11 displays dynamic compaction in progress.

Figure 4-11. Dynamic Compaction

Pile Foundation. If deep, weak soil conditions (for example of karst deposits, lake deposits, marshes, or uncontrolled fills) are found at a wind turbine site, a deep pile foundation may be required. The pile foundation consists of a reinforced concrete pile cap, similar in shape and size to a mat foundation, supported by a grid of piles. The pile can extend to depths as great as 100 feet. The type of pile used depends on the soil conditions and depth of installation required. The types of piles include driven H-piles and pipe piles, drilled concrete caissons, auger cast concrete piles, and drilled micropiles. Figure 4-12 shows a typical pattern for driven

H-piles, and the integration of those piles into a mat foundation base. PCW does not anticipate that wind turbine sites within the CCSM Project Site will require pile foundations.

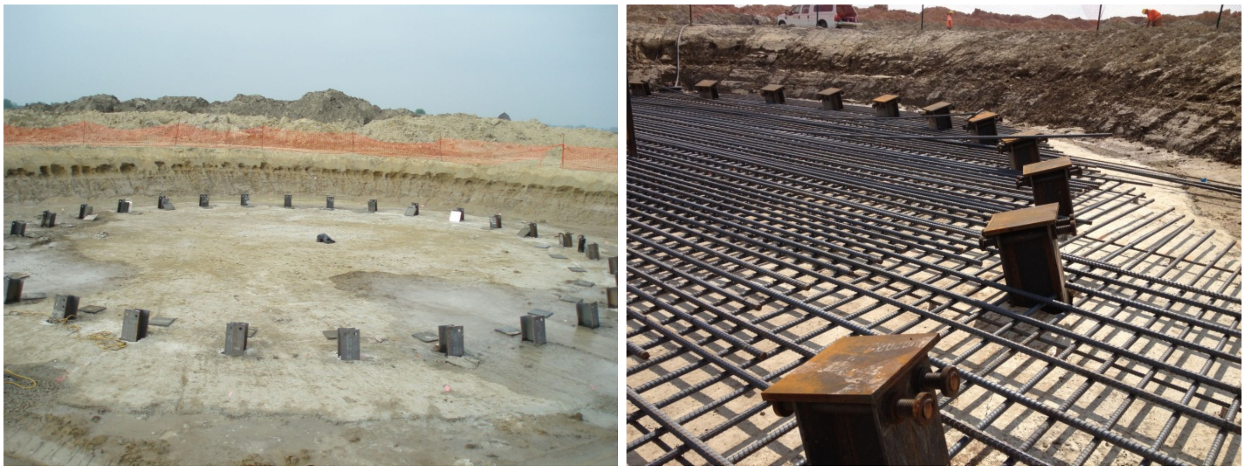

Figure 4-12. Pile Foundation

4.3.3.2 Overhead Electrical Structure Foundations

The overhead electrical lines for the CCSM Project use both wooden poles and steel monopole structures. Wooden poles will be directly embedded and will not require separate concrete foundations. Wooden poles will be placed into holes just larger than the pole diameter to a depth of up to 10 feet (some soil conditions may require up to 15 feet). After the poles are placed into the holes and aligned, the holes are backfilled with native material, aggregate or a small amount of concrete.

Steel monopole structures, such as those for the overhead transmission lines, will be secured to a concrete foundation. PCW anticipates using drilled concrete piers ranging from 4 to 12 feet in diameter placed from 15 to 60 feet deep. The piers will use anchor bolt cages with reinforcing steel.

4.3.3.3 Meteorological Tower Foundations

Non-guyed steel lattice towers, such as the meteorological towers on the CCSM Project, will use pad/pier foundations where piers connect each of the tower's three legs to a shallow pad foundation. As shown in Figure 4-13, the piers typically go 3 to 4 feet below grade to a square pad about 20 feet per side and 1.5 feet thick.

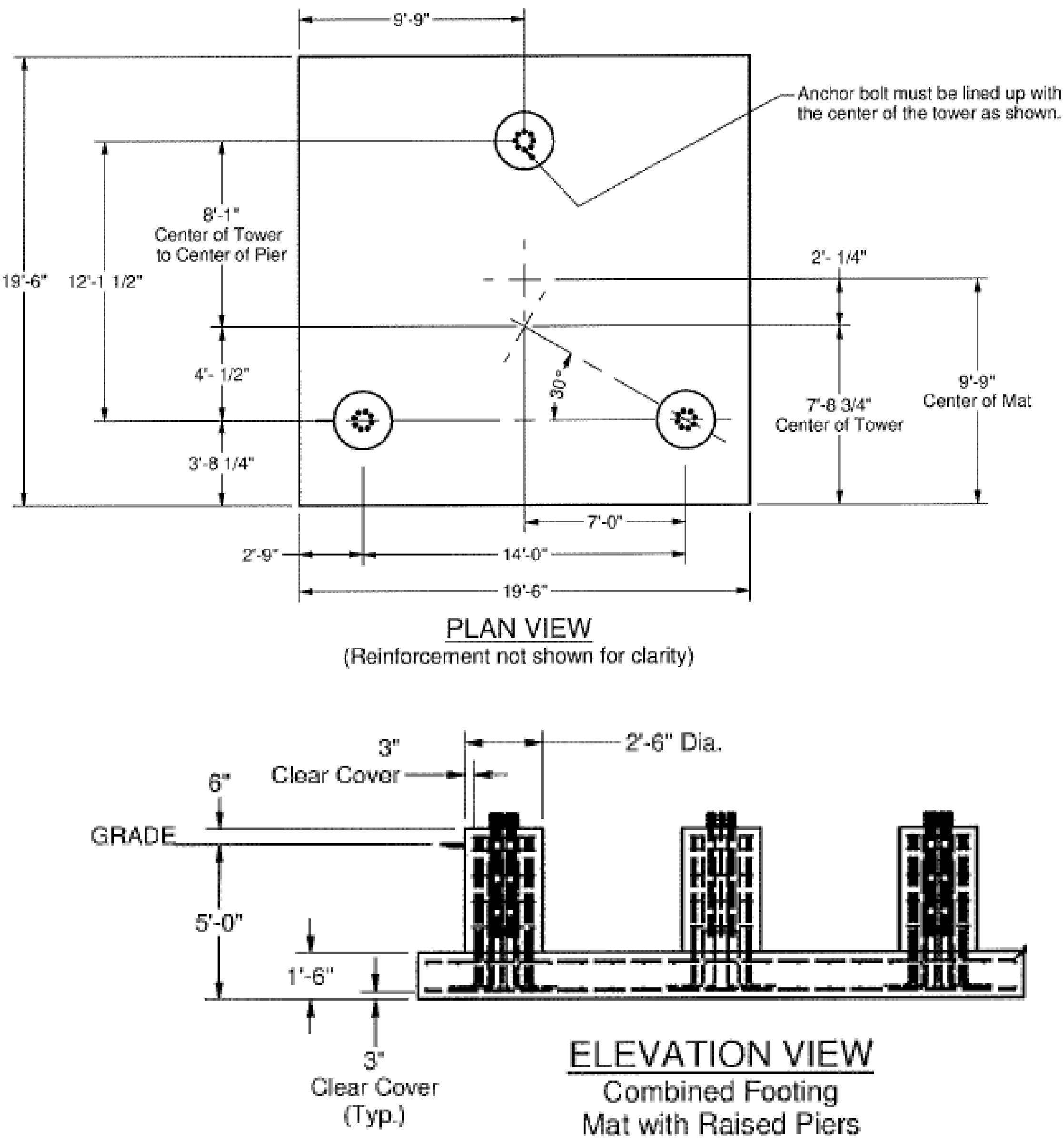

Figure 4-13. Met Tower Pad/Pier Foundation Diagram

4.3.3.4 Electrical Device Foundations

The Phase I Wind Turbine Development includes a range of electrical devices from large substation transformers to smaller electrical junction boxes, each of which requires a foundation. Where feasible, prefabricated foundations will be purchased and placed on-site. For larger devices where prefabricated foundations are not practical, PCW will construct cast-in-place reinforced concrete foundations.

4.3.3.5 Building Foundations

The Phase I Wind Turbine Development buildings will use cast-in-place foundations designed for the site-specific soil and climate conditions. These foundations will consist of two primary components. First, the base of the foundation will be footings on which the foundation walls will rest. These footings will be approximately 2 feet wide and 1 foot in height. The second component will be the foundation walls, which are expected to be approximately 1 foot wide and 4 feet in height. Rebar will run between the footings and foundation wall to join the two components. Figure 4-14 below provides a typical diagram for the building foundations.

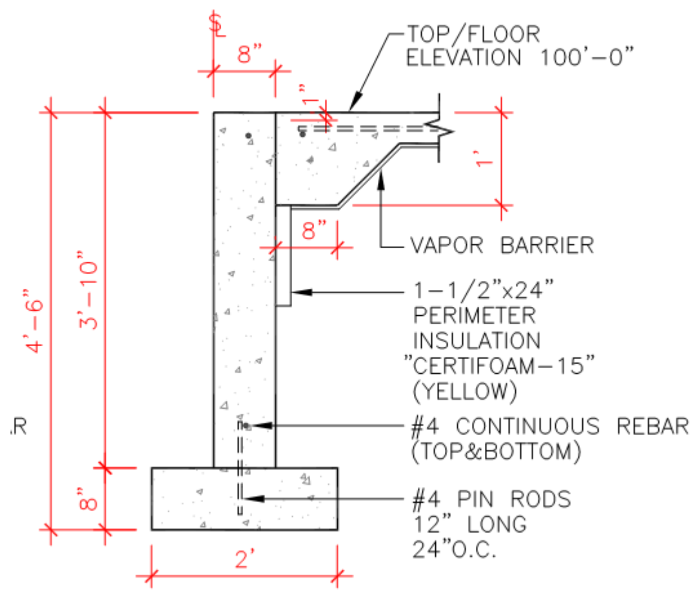

Figure 4-14. Building Foundation Diagram

4.3.4 Wind Turbines

Wind turbines are the primary element of the Phase I Wind Turbine Development, as they are the devices that convert the wind's kinetic energy into the electrical energy needed to meet the objectives of the CCMS Project. As described in the EIS and shown in Figure 4-15 and Figure 4-16, wind turbines consist of a nacelle, rotor, and tower (BLM 2012a). Wind turbines are not specifically designed for each project. Rather, wind turbines are designed according to industry standards to meet a range of wind and site conditions. For utility-scale wind turbines such as those required for the CCSM Project, vendors will review the wind data provided for the CCSM Project and offer a model(s) that meets the requirements of the observed and predicted wind conditions. PCW is still evaluating wind turbine options for the Phase I Wind Turbine Development; however, all turbine models under consideration have the same general configuration shown in Figure 4-15, i.e., single-rotor, three-bladed upwind horizontal-axis design on a tubular tower. In addition, as analyzed in the EIS, all turbine models under consideration have rotor diameters up to 120 meters and towers up to 100 meters tall.

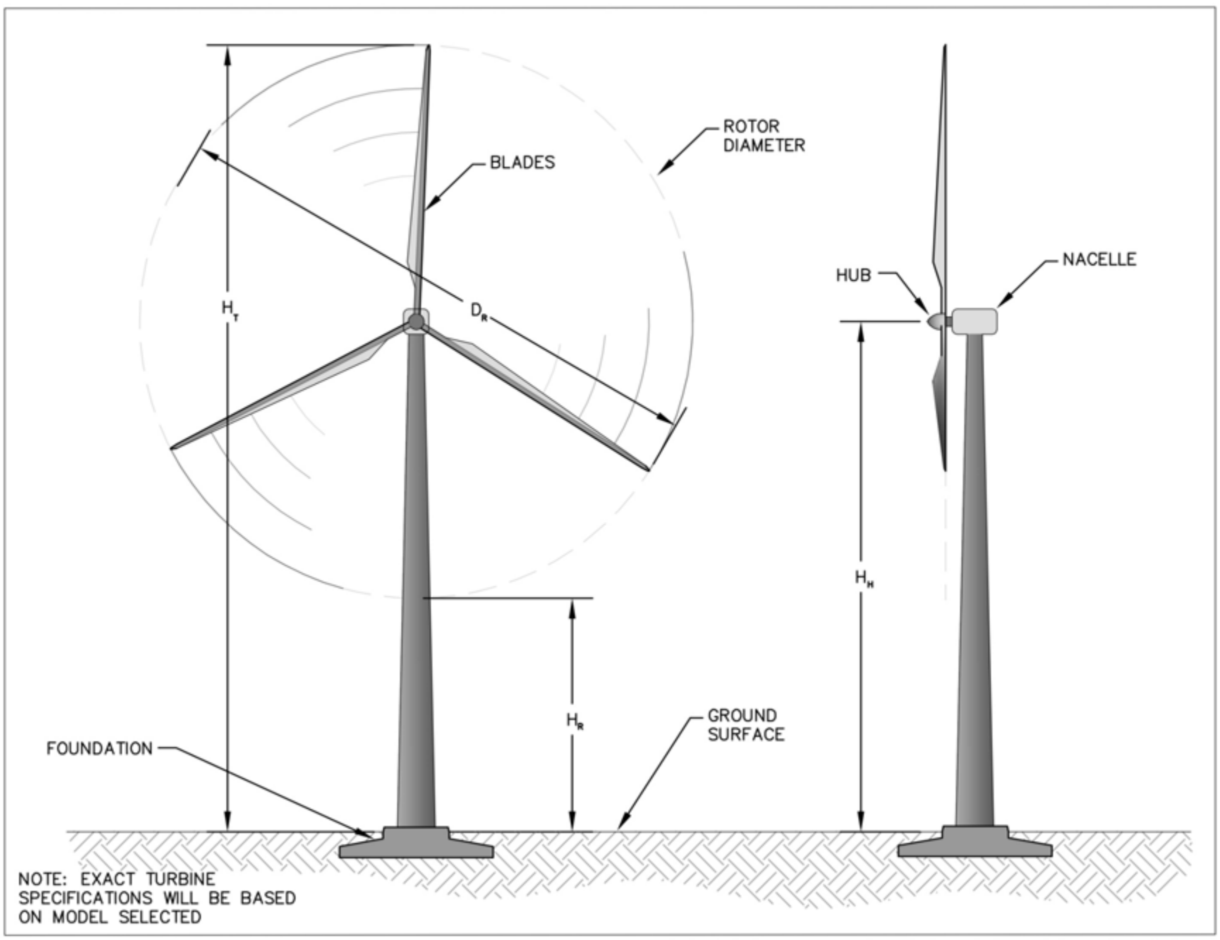

Figure 4-15. Wind Turbine Diagram

Figure 4-16. Example Modern Wind Turbines in Wyoming

4.3.5 Collection System

Wind turbines are connected together electrically using a collection system to transmit electricity to the electric grid. Based on the nameplate capacity and the areal extent of the Phase I Wind Turbine Development, PCW determined that it is most efficient to use a medium voltage collection system (34.5 kV); low voltage would have large losses and require many more connections. The Phase I Wind Turbine Development collection system is shown in detail in Appendix B.

In the Phase I Wind Turbine Development collection system, multiple turbines are grouped together onto a single collection circuit that is routed to nearby collection substations (Section 4.3.6.1). The collection circuits use a combination of underground cables and overhead lines to connect the wind turbines to the collection substation. The design of the collection system, including where underground and overhead lines are used, is based on the wind turbine and substation locations as well as a wide range of technical, environmental, and economic factors. Underground electric lines are typically used for connection between adjacent wind turbines.

Once the number of turbines connected to a collection circuit reaches the design limit, that circuit is connected back to a collection substation via a dedicated connection (often called a “home run”). In general, shorter home runs will be made with underground cables, and longer home runs will be made with overhead lines, although technical, topographic, or environmental issues affect which solution is used (for example, multiple circuits can be accommodated on an overhead line).

4.3.5.1 Wind Turbine Connections

Underground collection cables will be connected to a wind turbine either at the turbine's base, or to an adjacent padmount transformer, depending upon the turbine's design. The collection cables will be brought into the tower through conduits inside the tower foundation. The collection cables will then be routed either to the next adjacent turbine, to a larger collection circuit, or back to a collection substation based upon the turbine location.

4.3.5.2 Underground

The underground portions of the collection system will consist of the power cables (three single-conductor cables), trench ground conductor, and fiber optic cable buried together in a trench. The power cable is a 35 kV-class cable suitable for direct burial. The main power conductor is made of stranded aluminum, and is insulated with either tree-retardant cross-linked polyethylene (TR-XLPE) or ethylene propylene rubber (EPR) (Figure 4-17). Each cable has a copper concentric neutral and a poly-ethylene (PE) jacket. The trench ground conductor is made of stranded bare copper wire or stranded copper-clad steel wire. The fiber optic cable is a single-mode fiber optic cable that contains twelve separate fibers in a single cable. A typical trench cross section showing the power cables, trench ground conductor, and fiber optic cable is shown in Appendix B.

Three single-conductor cables are used as opposed to a three-conductor cable to allow for sufficient power capacity and efficient construction. A three-conductor cable has significantly less power capacity than three single-conductor cables and more trenches would be needed to carry the same amount of power if three-conductor cables were used. The three single-conductor power cables are arranged in a "trefoil" configuration, where each cable is touching the other two in a triangular configuration. This method helps to balance the three-phase system and can allow for a narrower trench to be used as compared to a horizontal placement configuration. In locations where underground circuits are run in parallel, each circuit will have a dedicated trench and will be separated by a minimum of twelve feet in order to avoid de-rating the cables due to effects of mutual heating.

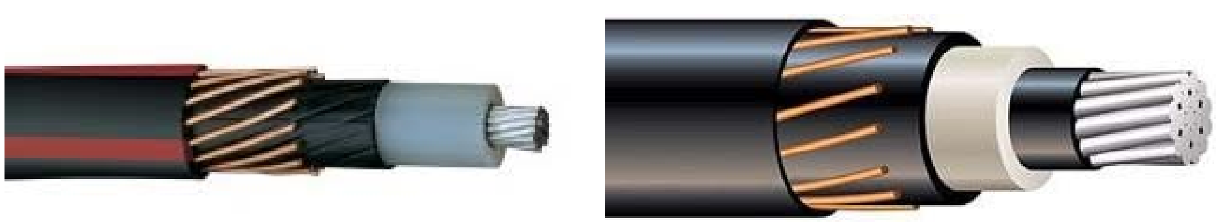

Figure 4-17. Typical TR-XLP (left) and ERP (right) Cable

At locations where sections of cable are joined together (such as T-junctions or along long runs of cable), it will be necessary to use a splice box in order to join segments together for a single circuit. Above ground splice boxes or junction boxes will be used to allow for ease of access in the event maintenance is required, and also to allow for proper acceptance testing during installation. Figure 4-18 shows an example junction box at an operating wind project. Splice boxes and junction boxes are typically located alongside roads to allow for easy access, and are protected from vehicles using concrete bollards.

Figure 4-18. Examples of Junction Boxes

4.3.5.3 Overhead

Overhead lines have been used in the Phase I Wind Turbine Development collection system design to minimize disturbance, collection system lengths, and electrical losses. One or more underground collection circuits can be connected to a single overhead collection line, allowing for more wind turbines to be connected to a given overhead line, reducing the overall number of circuits needed and minimizing the size of the substations. Underground collection circuits will transition and connect to an overhead line via a “riser pole” similar to the example shown in Figure 4-19. A given circuit may have multiple riser poles to allow multiple segments to feed into the overhead line homerun.

The Phase I Wind Turbine Development overhead collection lines will primarily use steel poles. Using steel poles minimizes ground disturbance by allowing for fewer poles spread wider apart and the use of double-circuit structures (carrying two sets of overhead lines instead of one) to eliminate unnecessary parallel lines. PCW will still use wood poles for single-circuit segments of the overhead collection system where feasible. Regardless of structure material type, the vast majority of overhead collection line structures will be directly embedded into the ground rather than use separate foundations (Section 4.3.3.2). All overhead collection line structures will be finished in accordance with mitigation measure VR-1 in Appendix A. To the extent practical, the overhead collection system follows terrain features such as valleys or the base of ridgelines in order to reduce the visual effect of the overhead lines.

PCW will use overhead collection system lines between the Upper Miller Hill turbines and the substations in Lower Miller Hill to eliminate the need to trench down steep slopes and to avoid the need for additional substations in Upper Miller Hill. Overhead lines will also be used in the Lower Miller Hill and Nevins Ridge to collect and transmit power from groups of turbines distant from the substations to minimize the necessary ground disturbance and electrical losses.

Avian Power Line Interaction Committee (APLIC) has issued guidelines designed to reduce operational and avian risks that result from avian interactions with electric facilities.[10] The Phase I Wind Turbine Development collection system will be designed to APLIC recommendations by ensuring that vertical and horizontal separation distances between energized components and between energized components and grounded elements meet or exceed APLIC recommendations of the "wrist-to-wrist" measurements of the largest bird that may occur within the local vicinity of the CCSM Project (golden eagles).

Figure 4-19. Example Riser Pole Structure

[10] Mitigating Bird Collisions with Power Lines: The State of the Art in 2012 (APLIC 2012); Avian Protection Plan Guidelines (APLIC 2005); Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006)

4.3.5.4 SCADA

In order to ensure safe and efficient operation of the Phase I Wind Turbine Development, each wind turbine is connected to a central Supervisory Control and Data Acquisition (SCADA) system which allows for the turbines to be controlled and monitored remotely. The turbines are connected together with fiber optics that are co-located with the collection system. Monitoring and control of the Phase I Wind Turbine Development will occur at the Operations Center (see Section 4.3.8.2).

4.3.6 Substations

Substations gather the power generated by the wind turbines through the electrical collection system and facilitate connection to the electrical grid. The design of the Phase I Wind Turbine Development substations is described below.

Avian Power Line Interaction Committee (APLIC) has issued guidelines designed to reduce operational and avian risks that result from avian interactions with electric facilities.[11] The Phase I Wind Turbine Development substations will be designed to APLIC recommendations by ensuring that vertical and horizontal separation distances between energized components and between energized components and grounded elements meet or exceed APLIC recommendations of the "wrist-to-wrist" measurements of the largest bird that may occur within the local vicinity of the CCSM Project (golden eagles).

4.3.6.1 Collection Substations

The Phase I Wind Turbine Development collection substations are used to "collect" generation from groups of wind turbines within the regions of the Phase I Wind Turbine Development Site. This is done by connecting all of the collection circuits from the region to the collection substation. Within the collection substation, the power is then increased in voltage and placed on the internal transmission system. The design requirements for the collection substations and the resulting design are described below.

[11] Mitigating Bird Collisions with Power Lines: The State of the Art in 2012 (APLIC 2012); Avian Protection Plan Guidelines (APLIC 2005); Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006)

4.3.6.1.1 Collection Substation Design Requirements

The collection substations will be designed in accordance with applicable standards, including the standards of the following groups:

- American Concrete Institute
- American Iron and Steel Institute
- American Institute of Steel Construction
- American National Standards Institute
- American Society of Civil Engineers
- American Society of Heating Ventilation and Air Conditioning Engineers
- American Society of Mechanical Engineers
- American Society of Testing and Materials
- American Welding Society
- Association of Edison Illuminating Companies
- American Institute of Steel Construction Standard Practice
- Illuminating Engineering Society of America
- Institute of Electrical and Electronics Engineers
- Insulated Cable Engineering Association
- International Electro-Technical Commission
- International Electrical Testing Association
- International Standards Organization
- North American Electric Reliability Corporation
- National Electrical Safety Code
- National Electrical Code
- National Electrical Manufacturers Association
- National Fire Protection Association
- Western Electricity Coordinating Council
- Underwriters Laboratories

4.3.6.1.2 Collection Substation Design

Four substations are included in the Phase I Wind Turbine Development. Two (Nevins Valley and Smith Draw) will be located in the Nevins Ridge region and two (McCarthy and Pine Grove) will be located in the Lower Miller Hill region. The Issued for Permit Plans in Appendix B depict each substation. All four substations will be the same size when completed and thus will require the same amount of long-term disturbance. Due to varying site conditions in regards to soils, slopes, laydown areas, and other considerations, initial disturbances vary (see Table 4.6).

Table 4.6. Phase I Wind Turbine Development Collection Substations

Substation	Number Wind Turbines	Number Transformers	Initial Disturbance (acres)	Long-Term Disturbance (acres)
Nevins Valley	112	3	13	6
Smith Draw	90	3	16	6
McCarthy	158	3	12	6
Pine Grove	140	3	16	6
TOTAL	500	12	57	24

The major equipment found within each substation includes power transformers, aluminum and steel buswork and structures, circuit breakers and other protective devices, relaying and control instrumentation, area lighting, and a control house. The protection and relaying systems, station lighting, and equipment heating systems will use battery backup systems. Portable generators may also be used in the event of a long-term outage, but no bulk fuel will be permanently stored at the substations. An example collection substation under construction is shown below in Figure 4-20.

Electrically, the collection substations will be designed identically, except that the number of incoming collection circuits may vary. The collection circuits will be routed to a single side of each substation and then connected to the air-insulated 34.5 kV bus via a circuit breaker in a single-bus single-breaker (also known as a radial) configuration. Disconnect switches will be installed to isolate the breaker during maintenance. The 34.5 kV bus will be divided into three sections, one for each transformer. The number of turbines connected to each transformer will vary as well due to the geographic distribution of the wind turbines. The three sections of the 34.5 kV bus will be connected to each other via a total of two circuit tie-breakers. This allows for full utilization of all turbines if a transformer is off-line for maintenance during light wind loading conditions.

The three transformers and the outgoing (and in the case of McCarthy and Nevins Valley substations, the incoming) internal transmission line are directly connected to the air-insulated high voltage bus in a ring-bus configuration. Separating the transformers and transmission lines from each other along the bus is a single circuit breaker and associated disconnect switches. At high voltages, a ring bus configuration allows for an efficient way to connect transformers and transmission lines together while having added reliability as compared to a radial configuration. For substation layout drawings, please refer to Appendix B.

Physically, the substations will have the same outside dimensions as well as the same internal dimensions for similar equipment. Surrounding the perimeter of the substation will be a fence to keep out livestock, wildlife, and unauthorized personnel. The substation gravel surface will be graded to account for water drainage from both the site itself and any water that may flow into the site from terrain at higher elevations. All non-conducting metallic surfaces that have a possibility of becoming energized will be grounded including the perimeter fence. The control building will be a modular building designed specifically for this purpose, built and wired off-site and then transported to the substation site for installation (Section 4.3.8).

Figure 4-20. Example Wind Energy Collection Substation

4.3.6.2 Interconnection Substation

The Overland Substation is an interconnection substation which is the CCSM Project's connection point to the electrical grid. This substation will operate entirely at 230kV, and will collect the generation from the internal transmission system onto two main buses. From there it will be connected to external transmission lines.

4.3.6.2.1 Interconnection Substation Design Requirements

The design requirements for the Overland Substation are the same as for the collection substations, see Section 4.3.6.1 for details.

4.3.6.2.2 Interconnection Substation Design

The Overland Substation will support the interconnection for the entire CCSM Project, and will be built in conjunction with the Phase I Wind Turbine Development. The purpose of the Overland Substation is to connect the CCSM Project to external transmission lines. The most efficient location for the Overland Substation is in T21N R86W S31 along the outer edge of the CCSM Project Site near the external transmission lines. Diagrams of the Overland Substation location are provided in Appendix B.

The Overland Substation is anticipated to have an initial disturbance of 60 acres and a long-term disturbance of 32 acres. The major equipment within the substation will include aluminum and steel buswork and structures, circuit breakers and other protective devices, relaying and control instrumentation, reactive devices, filter banks, area lighting, and a control house. The protection and relaying systems, station lighting, and equipment heating systems will utilize battery backup systems. Portable generators may be used in the event of a long-term outage, however no bulk fuel will be permanently stored at the Overland Substation.

Electrically, the Overland Substation is designed to accept the incoming power from the CCSM Project transmission system, as well as existing and future utility transmission lines. Incoming transmission will be routed into the substation and will be connected to the air-insulated 230kV buses via a circuit breaker in a double-bus, breaker and a half configuration. Disconnect switches will be installed to isolate the breaker during maintenance. The design allows for reactive devices and filter banks to be connected to the 230 kV bus as needed based on the final interconnection requirements.

Surrounding the perimeter of the Overland Substation will be a fence to keep out livestock, wildlife, and unauthorized personnel. The substation gravel surface will be graded to account for water drainage from both the site itself and any water that may flow into the site from terrain at higher elevations. All non-conducting metallic surfaces that have a possibility of becoming energized will be grounded including the perimeter fence. The control house will be a modular building designed specifically for this purpose, built and wired off-site and then transported to the substation site for installation. This method is typical in the utility industry.

4.3.7 Internal Transmission System

The CCSM Project's 230 kV internal transmission lines will transfer the electrical generation from the collection substations to the interconnection substation. Detailed information on the internal transmission system is included in Appendix B.

The Phase I Wind Turbine Development internal transmission system is 230 kV. The use of 230 kV lines reduces the number of lines and allows PCW to design and build the internal transmission system to standards consistent with the utilities operating in the region (such as Rocky Mountain Power, Tri-State Generation and Transmission Association, and Western Area Power Administration). The transmission line corridors will follow CCSM Project roads as closely as practicable, reducing the need for parallel transmission structure access roads. However, PCW will construct structure roads where necessary to access transmission structures from nearby CCSM Project roads.

PCW intends to construct the internal transmission lines using steel monopole structures to minimize impacts to wildlife in accordance with Appendix A. Minimum horizontal and vertical clearances will be calculated using National Electric Safety Code (NESC) or similar requirements. The structures will be finished in accordance with mitigation measure VR-1 in Appendix A. The structures will use vertical or delta configuration to minimize the required distance between parallel circuits. Additionally, double circuit structures will be employed wherever practical to eliminate or reduce the need for parallel structures and the associated ground disturbance. Example structures and configurations are shown in Figure 4-21.

Figure 4-21. Typical Monopole Transmission Towers

The Phase I Wind Turbine Development internal transmission system includes two primary transmission lines: Line A will connect the Pine Grove and McCarthy collection substations to the Overland Substation and Line B will connect the Smith Draw and Nevins Valley collection substations to the Overland Substation. PCW has identified the areas around each transmission structure required for construction, including those areas where cable reel trucks and tensioning equipment will need to be staged, in Appendix B.

Avian Power Line Interaction Committee (APLIC) has issued guidelines designed to reduce operational and avian risks that result from avian interactions with electric facilities.[12] The Phase I Wind Turbine Development internal transmission system will be designed to APLIC recommendations by ensuring that vertical and horizontal separation distances between energized components and between energized components and grounded elements meet or exceed APLIC recommendations of the "wrist-to-wrist" measurements of the largest bird that may occur within the local vicinity of the CCSM Project (golden eagles).

4.3.8 Buildings

The Phase I Wind Turbine Development includes two types of buildings: the Operations Center, and two maintenance buildings. Design and construction of these buildings will conform to the International Building Code along with applicable local code requirements.

4.3.8.1 Design Requirements

The Phase I Wind Turbine Development buildings will be prefabricated and designed for the site's climate conditions. Once PCW selects a vendor, the architect for that vendor will review the site conditions and the International Building Code to determine the applicable design requirements. Based on regional projects, PCW anticipates the design criteria to be similar to those presented in Table 4.7.

[12] Mitigating Bird Collisions with Power Lines: The State of the Art in 2012 (APLIC 2012); Avian Protection Plan Guidelines (APLIC 2005); Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006)

Table 4.7. Anticipated Building Design Requirements

Criteria	Requirement
Roof live load	20 PSF
Metal building collateral roof dead load	3.0 PSF
Slab on grade live load	150 PSF
Basic wind speed	90 mph
Site exposure class	C
Seismic design category	B
Seismic site class	D

In addition to the criteria listed above, all buildings will comply with applicable federal, state and local codes, e.g., the International Mechanical Code for heating, ventilation, and air conditioning (HVAC) equipment and the National Electrical Code for the electrical installation.

4.3.8.2 Operations Center

The CCSM Project Operations Center will be located north of the Chokecherry WDA along the North Road. Specifically, the Operations Center will be in T21N R86W S33. The Operations Center will be a single-level prefabricated office building assembled on-site (Figure 4-22). It will consist of approximately 5,000 sq. ft. of office space, and 2,500 sq. ft. high-bay. The office area will include the primary training facility, locker rooms, and a break room for the CCSM Project workforce, plus offices and conference rooms. The office area will also have a secure operations control room and server room where operators will continuously monitor the status of the CCSM Project and dispatch maintenance crews as needed.

The high-bay of the Operations Center will have 20 foot ceilings and will house critical spare parts in a temperature controlled environment. The area will be equipped with bay doors to allow trucks to deliver and retrieve the spare parts. Parking will be provided around the Operations Center for the CCSM Project vehicles and staff personal vehicles. PCW will connect the Operations Center to utilities, as described in Section 4.3.10.

Figure 4-22. Example Wind Energy Operations Center

4.3.8.3 Maintenance Buildings

PCW will construct two maintenance buildings within the Phase I Wind Turbine Development Site. The buildings will provide spare parts storage and maintenance workspace. The first will be the Chokecherry maintenance building, to be constructed in T20N R87W S19 within the Nevins Valley area near the Chokecherry Knob feature. This maintenance building will support the wind turbines in the Chokecherry portion of the CCSM Project. The second will be the Sierra Madre maintenance building, to be constructed in T18N R88W S12 within the Lower Miller Hill area along CR401 (Sage Creek Road). This maintenance building will support the wind turbines in the Sierra Madre portion of the CCSM Project.

The CCSM Project maintenance buildings will consist of a 2,500 sq. ft. office area and a 5,000 sq. ft high-bay. The office area will include a conference and break area, workstations, and restrooms for use by operations and maintenance staff. Similar to the Operations Center, the maintenance buildings' high-bays will be used for storage in an environmentally-controlled building. Some shop-space will also be included for inspection and repairs. Photos of similar wind energy project maintenance buildings are provided in Figure 4-23. PCW will connect the maintenance buildings to utilities, as described in Section 4.3.10.

Figure 4-23. Example Wind Energy Maintenance Buildings

4.3.9 Meteorological Towers

The CCSM Project will include meteorological towers to measure the wind conditions for efficient operation of the wind turbines. PCW has two primary objectives for the meteorological towers:

- **Turbine performance verification.** The wind speeds measured at the meteorological towers will be used to verify the nearby turbines are generating expected levels of power. These comparisons will be evaluated continuously by the CCSM Project's operators to look for performance issues that could indicate the need for required maintenance.
- **Forecasting.** The wind speed data will be evaluated by complex wind forecasting models to prepare day-ahead and hour-ahead performance estimates. PCW will use this forecasting to coordinate power delivery to the grid.

The Phase I Wind Turbine Development includes 10 meteorological towers: 4 in Upper Miller Hill, 3 in Lower Miller Hill, and 3 in Nevins Ridge. All meteorological towers are designed to meet the requirements of ANSI/TIA-222-G *Structural Steel Standards for Steel Antenna Towers and Supporting Structures*. Weather conditions recorded on-site and known regional conditions are used to select the proper wind and ice loading design parameters for the towers. Furthermore, the design of the meteorological tower will provide consistent and minimal aerodynamic obstruction to facilitate accurate wind speed measurements.

PCW has elected to use self-supporting lattice meteorological towers (Appendix B) based on the above design requirements and to minimize impacts to wildlife (Appendix A). To collect the required data, the tower will be equipped with wind speed and direction instruments at the turbine hub height and at the bottom of the rotor sweep. This will allow PCW to evaluate the wind conditions at multiple locations throughout the wind turbines' rotor swept area. PCW may also install additional monitoring equipment on the towers, including remote cameras. Meteorological towers will have fiber optic and power connections to the nearest wind turbine to provide data to the CCSM Project SCADA system. Given the height of the meteorological towers, it is likely each will be equipped with an aviation warning light.

4.3.10 Utilities

In addition to the Phase I Wind Turbine Development elements described above, utilities are required for operation of the Phase I Wind Turbine Development. These include the water, sewer, and electrical power connections described below.

4.3.10.1 Water

To meet the water demands of the CCSM Project, the Phase I Wind Turbine Development design includes water supply infrastructure. The water supply infrastructure that will be developed as part of the Phase I Wind Turbine Development is in addition to the water supply infrastructure included in the Phase I Haul Road and Facilities. The primary components of the CCSM Project water system are shown on Figure 4-24 and Figure 4-25; those elements within the Phase I Wind Turbine Development are described below. The Phase I Wind Turbine Development water supply facilities are also detailed in Appendix B.

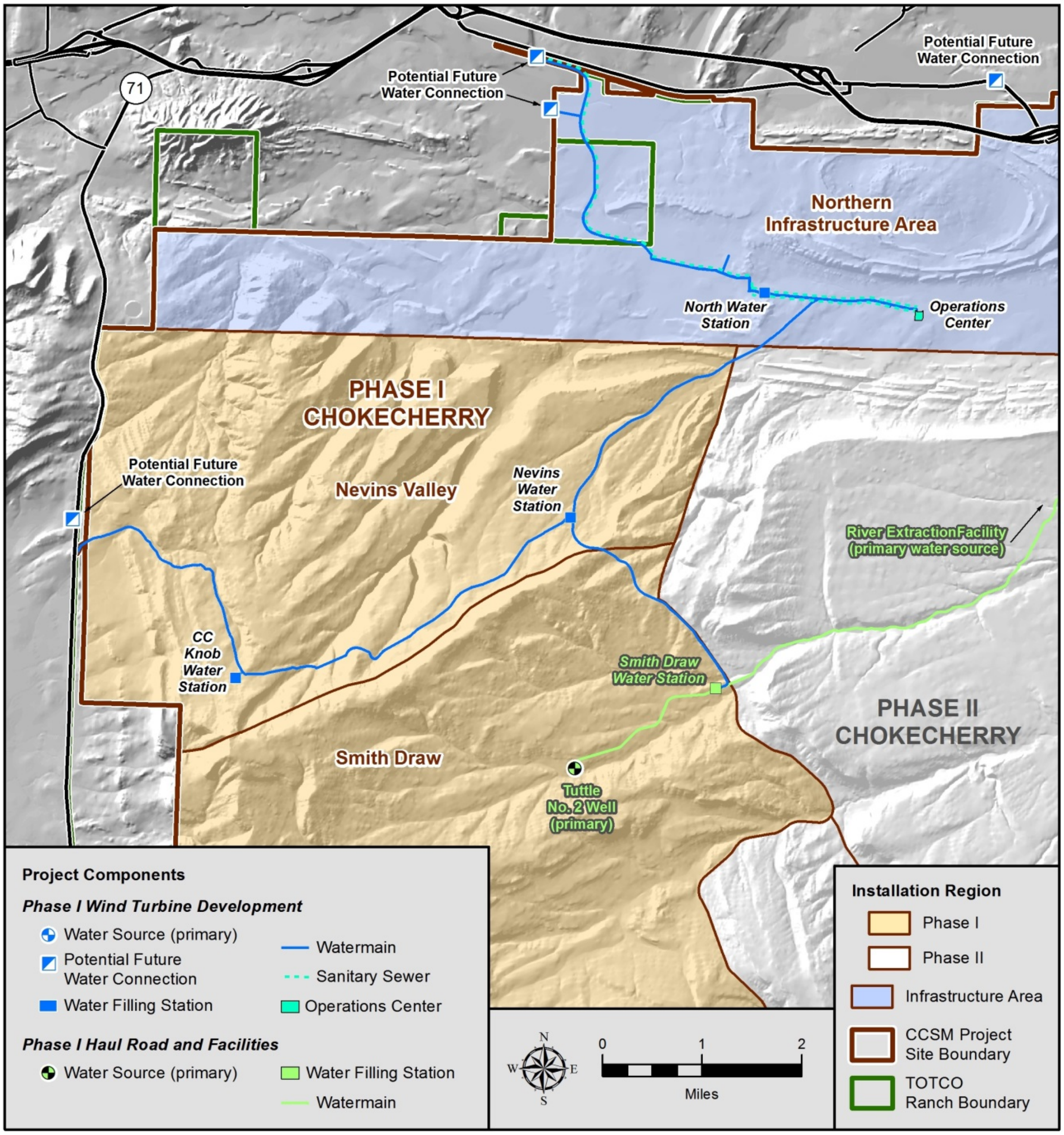

Figure 4-24. CCSM Project Water System – Chokecherry

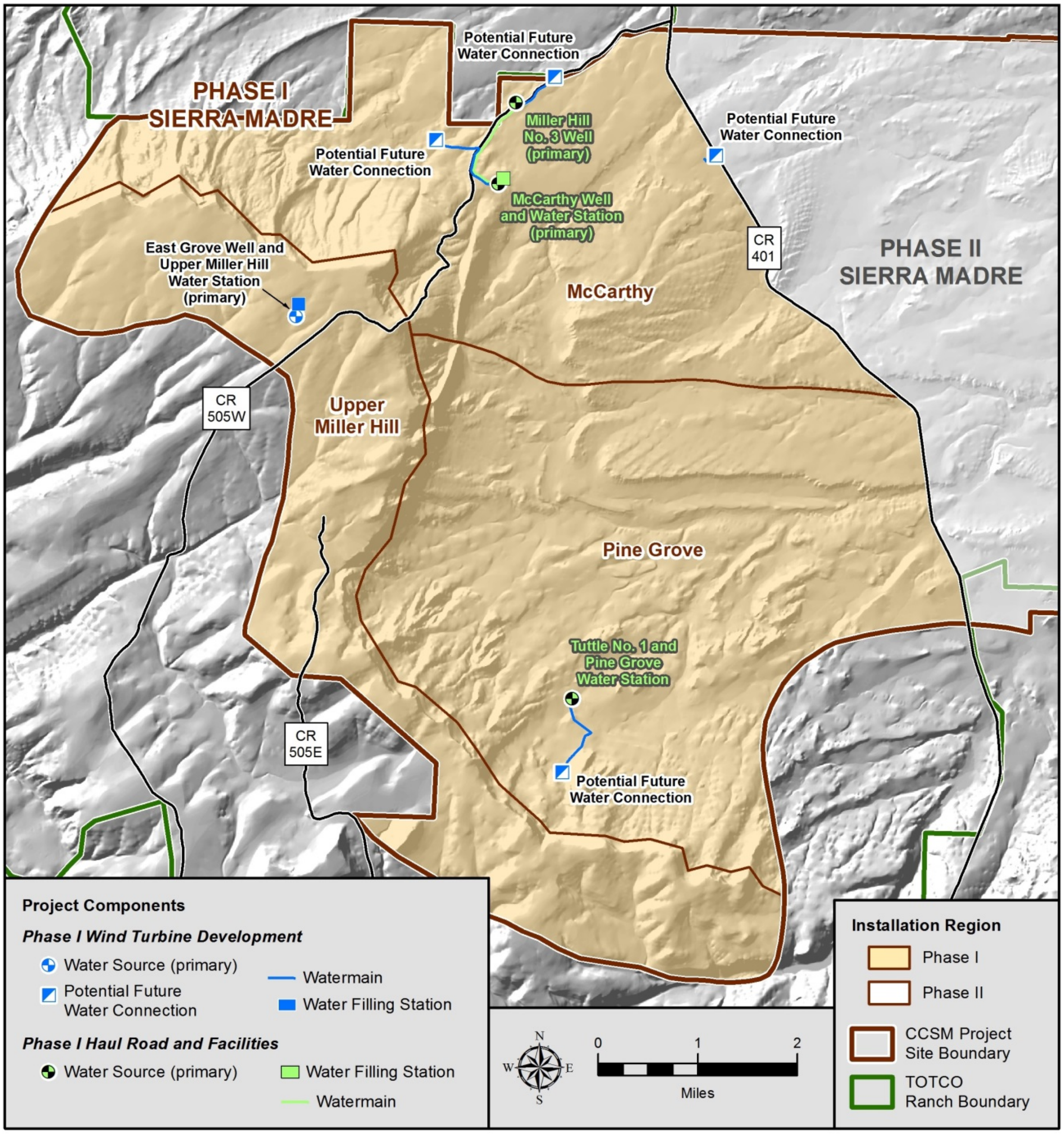

Figure 4-25. CCSM Project Water System – Sierra Madre

4.3.10.1.1 Groundwater Wells

The Phase I Wind Turbine Development includes connections to three groundwater wells: one proposed connection (East Grove 1701) and two potential future connections to other TOTCO wells (Appendix B). PCW has identified three (3) likely methods to obtain water from the groundwater wells within the CCSM Project Site. The condition of each well will be evaluated prior to construction and the appropriated method will be selected.

- **Groundwater Option A: Submersible Pump with Pitless Adaptor:** A down-hole submersible pump and motor will be placed within the well and a discharge pipe will be connected below ground. An electrical control panel will be placed above ground, and plumbing, meters, and valves will be installed either in a cabinet or vault. No pit or wet well is required.
- **Groundwater Option B: Turbine Pump with Above-Ground Discharge:** An above-ground turbine pump will be placed adjacent to the well in an enclosure or small pumphouse. An intake pipe will be fit to the well and a discharge pipe connection will be located above-ground in the pumphouse. An electrical control panel will be placed above ground and plumbing, meters, and valves will be installed either in the pumphouse or a vault. No pit or wet well is required.
- **Groundwater Option C: Artesian Wells Flowing into Wet Well:** Natural discharge from an artesian well is directed into a wet well or cistern located downhill from the wellhead. A submersible or turbine pump is located in the wet well to pump the well water into a below-grade discharge pipe. The only above-ground features will be the electrical control and service panel with all other elements within the wet well or adjacent vault.

PCW anticipates that any pumps associated with the groundwater wells will be operated using diesel generators; however, Rocky Mountain Power has existing distribution lines near some of the wells. PCW will investigate opportunities to connect the pumps to the Rocky Mountain Power or CCSM Project distribution systems long-term.

4.3.10.1.2 Potential Municipal Connections

While the CCSM Project water supply is not dependent upon a connection to a municipal water supply, PCW has discussed the potential for the CCSM Project to connect to the City of Rawlins and/or the Town of Sinclair water supply systems. In the event that PCW enters into a municipal water supply agreement for the CCSM Project, the Phase I Wind Turbine Development design and disturbance estimate includes provisions for connections to these municipal water systems.

PCW has provided for potential future connections to municipal water for the Operations Center, both maintenance buildings, and the on-site accommodations (construction camp and RV park) (Figure 4-24 and Figure 4-25). If municipal water is not available, PCW has provided for connections to the CCSM Project water system at these locations along with on-site water storage and treatment. PCW may also simply provide "bottled" water at the maintenance buildings.

4.3.10.1.3 Water Pipelines

To connect water sources with water filling stations, the Phase I Wind Turbine Development includes buried water pipelines. Water pipelines range from 6-inch outside diameter High Density Polyethylene (HDPE) pipe to 14-inch outside diameter HDPE or PVC. To accommodate regional climate conditions, water pipelines will be buried approximately 72 inches below grade. Due to the length of pipelines and the overall rise in elevation between water sources and filling stations, PCW anticipates that booster stations may be required within the Chokecherry WDA. While the booster station locations have not yet been finalized, they will be co-located with other water supply system features (e.g., water filling stations) and will be within the limits of disturbance for those features. Each booster station will have an in-line pump, a diesel generator, and approximately 600 gallons of fuel storage. In areas where booster stations are near either existing or proposed electric distribution lines, PCW will explore making a connection to these lines to eliminate the need for the generator and fuel storage.

4.3.10.1.4 Water Filling Stations

Water filling stations are locations where water will be loaded onto trucks for use throughout the CCSM Project. The Phase I Wind Turbine Development design includes four water filling stations listed in Table 4.8 and shown on Figure 4-24 and Figure 4-25. These water stations are in addition to the water stations described in the Site-specific Plan of Development for the Phase I Haul Road and Facilities.

Table 4.8. Phase I Wind Turbine Development Water Filling Stations

Water Filling Station
North
Nevins Valley
Chokecherry Knob
Upper Miller Hill

Each water filling station will be arranged to maximize the efficiency of filling water trucks. Two (2) rows of water tanks (either elevated 12,000 gallon tanks or ground-mounted 21,000 gallon tanks most likely) will be connected to the incoming water pipeline via a water distribution network (Figure 4-26). Trucks will enter the station where station operators will direct them to park at one of the water tanks (Figure 4-27). Trucks will then be filled from the tank and will leave the station to distribute water throughout the CCSM Project Site. To maximize efficiency, each water filling station will likely have a small amount of fuel storage (approximately 500 gallons) with secondary containment so that trucks can be fueled at the same location. Water filling station operators will manage the filling of the tanks from the water pipeline, the flow of traffic, and truck refueling. Each water filling station will be located on between one (1) and two (2) acres with a slope of less than three (3) percent.

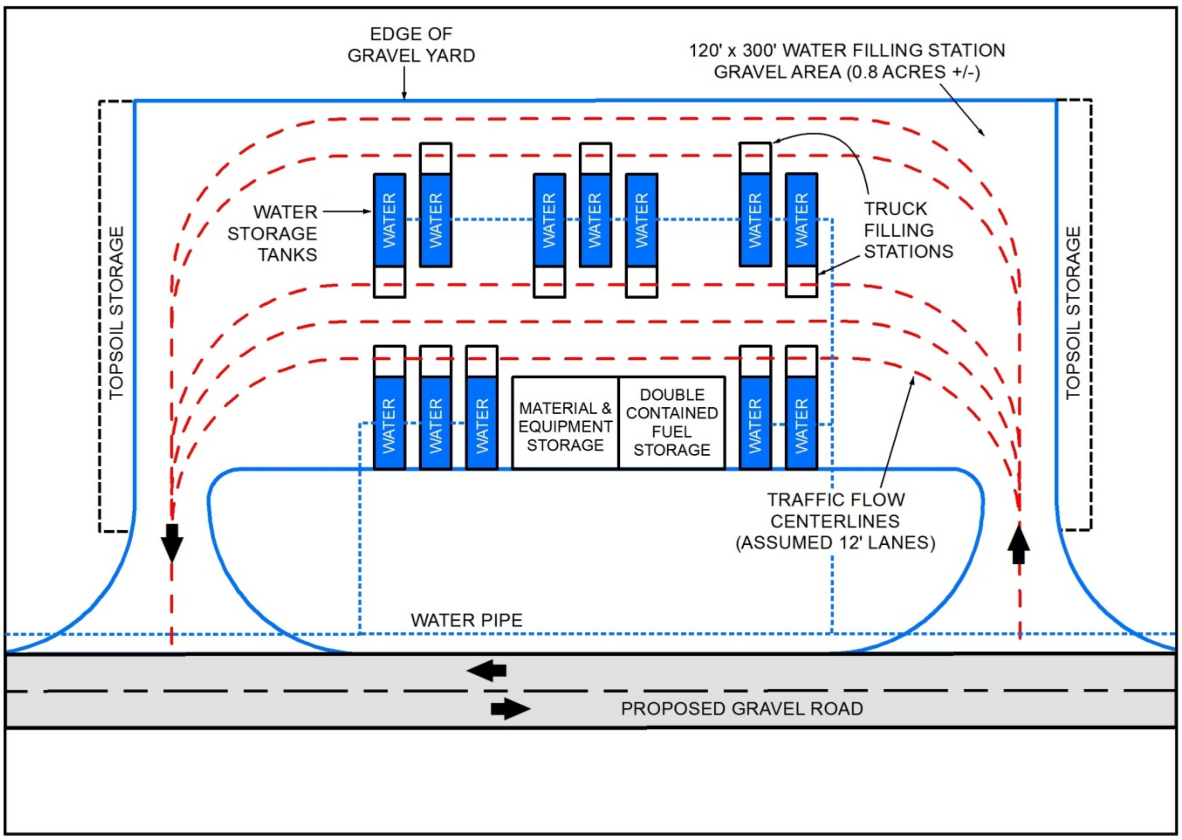

Figure 4-26. Typical Water Filling Station Arrangement

Figure 4-27. Typical Water Tanks

At the North Filling Station, PCW has included an above-ground potable water storage tank in the filling station design. This tank is intended to support the on-site accommodations and trailer complex during construction of the CCSM Project and the Operations Center and Overland Substation during operations. PCW has estimated the size of the tank at about 260,000 gallons to meet the potable water needs of the on-site accommodations. The potable water storage tank will likely be a glass-coated steel design installed on a concrete foundation. The dimensions of the tank are variable depending upon vendor, and could be up to 120 feet in height. The North water filling station has also been designed to provide for water treatment equipment if required.

4.3.10.2 Wastewater

PCW has provided for septic system installation at the Operations Center, Chokecherry Maintenance Building, Sierra Madre Maintenance Building, and the temporary on-site accommodations (Section 4.3.11.4). In addition, PCW may use portable toilets for temporary demands at the trailer complex and laydown yards. These facilities are included in the disturbance estimates and Issued for Permit Plans in Appendix B.

The design for the Phase I Wind Turbine Development also provides for potential future wastewater connections to the City of Rawlins wastewater treatment system for the Operations Center and on-site accommodations. These potential future wastewater connections are also included in the disturbance estimates and Issued for Permit Plans in Appendix B. While the CCSM Project is not dependent upon a connection to the City of Rawlins, PCW and the City of Rawlins continue to discuss a potential wastewater agreement.

Regardless of the wastewater solution, all sewer lines included in the Phase I Wind turbine Development design have been designed according to the Wyoming Department of Environmental Quality's requirements for sewer lines (WYDEQ Chapter 11 – sewerage systems) and Ten States Standards for wastewater. All sewer lines will maintain a minimum of 10 feet of separation from potable water lines. Where lift stations are included in the design they will consist of a concrete vault and wet well and either 2 or 3 pumps of the same size. The vault and wet well are designed to store wastewater while the pumps are off. The multiple pumps will alternate use and create a redundant system. If a pump fails, an alarm will go off indicating that maintenance is needed. Cleanouts and air release manholes will be located along the line per WYDEQ requirements. Pumps will be powered by the distribution lines adjacent to the lift stations.

4.3.10.3 Distribution Power

Several permanent and temporary CCSM Project elements will require electrical power to function. Those elements not directly integrated into the CCSM Project's electrical system will require external sources of power. PCW anticipates these features to include:

- **Permanent Elements**
  - Operations Center
  - maintenance buildings
  - water wells, booster stations, and lift stations
- **Temporary Elements**
  - construction trailers
  - on-site accommodations (construction camp and RV park)
  - laydown yards

For the CCSM Project elements on the north portion of the CCSM Project Site, PCW anticipates receiving this power through an overhead distribution line from Rocky Mountain Power. Rocky Mountain Power will design and install the line. The line will likely be routed along the Rail Facility's lead track and the North Road within the designated limits of disturbance. PCW will request that Rocky Mountain Power comply with the applicable terms and conditions of the ROD.

4.3.11 Temporary Features

In addition to the Phase I Wind Turbine Development elements described above, some temporary features will be necessary during construction. These temporary features are described below.

4.3.11.1 Laydown Yards

Laydown yards are required to support construction, operation, maintenance, and decommissioning of the CCSM Project. Laydown yards are used to store materials, components and equipment and to provide parking and locations for temporary facilities, e.g., construction trailers. PCW anticipates that construction of the CCSM Project will require a total of ten laydown yards. The Phase I Wind Turbine Development includes the establishment of two laydown yards (Smith Draw and East Deadman) and the expansion of three of the Phase I Haul Road and Facilities laydown yards (North, Chokecherry, and Miller Hill). A summary of the Phase I Wind Turbine Development laydown yards is presented in Table 4.9 below.

Table 4.9 CCSM Project Laydown Yards

Laydown Yard	Initial Disturbance (acres)	Long-term Disturbance (acres)
North	113	0
Smith Draw	37	0
Chokecherry	33	0
East Deadman	36	0
Miller Hill	35	0

Laydown yards range in size depending on requirements for storage and temporary facilities. Typical slopes of a laydown yard range between 0% and 6% following site preparation. Locations for the laydown yards were selected based on the existing topography and drainage to minimize disturbance; laydown yards are graded to smooth out rough terrain but typically do not require mass grading. If existing drainage patterns run through the yard, minor grading may be done to route the water around. If soil stability is a concern, geotextile fabric or geogrid could be used in a similar manner to that discussed in the CCSM Project Road Design Manual (Appendix C). After grading and stabilization is complete, a layer of aggregate is placed to help ensure yards remain accessible and useable. Depending on the availability and cost of Reclaimed Asphalt Pavement (RAP), PCW may mix RAP with aggregate for a combined layer of RAP and aggregate. The mix would contain at least 25% RAP and the surface would be graded smooth. As availability of RAP permits, stockpiles of RAP would be kept within each laydown yard for maintenance during construction.

The Phase I Wind Turbine Development laydown yards will have locations for vehicle and equipment parking, material storage, portable sanitation facilities and waste storage. An area for vehicle refueling and fuel storage will also be established in each laydown yard. All fuel and oil will be stored in accordance with the requirements of the Spill Prevention, Control and Countermeasures Plan (SPCC Plan) (Appendix Q). Figure 4-28 shows a typical laydown yard arrangement; however, the layout of each laydown yard will vary based upon the parcel size, parcel shape, and usage.

The North laydown yard has been identified as the primary location for temporary construction trailers for the CCSM Project; however, some contractors may choose to set up additional construction trailers within the other CCSM Project laydown yards when the work will take place farther away. For construction of the Phase I Wind Turbine Development, PCW is anticipating that up to six (6) double-wide and ten (10) single-wide temporary construction trailers will be required at the North laydown yard, with no more than three (3) additional single-wide trailers at any other laydown yard on a temporary basis.

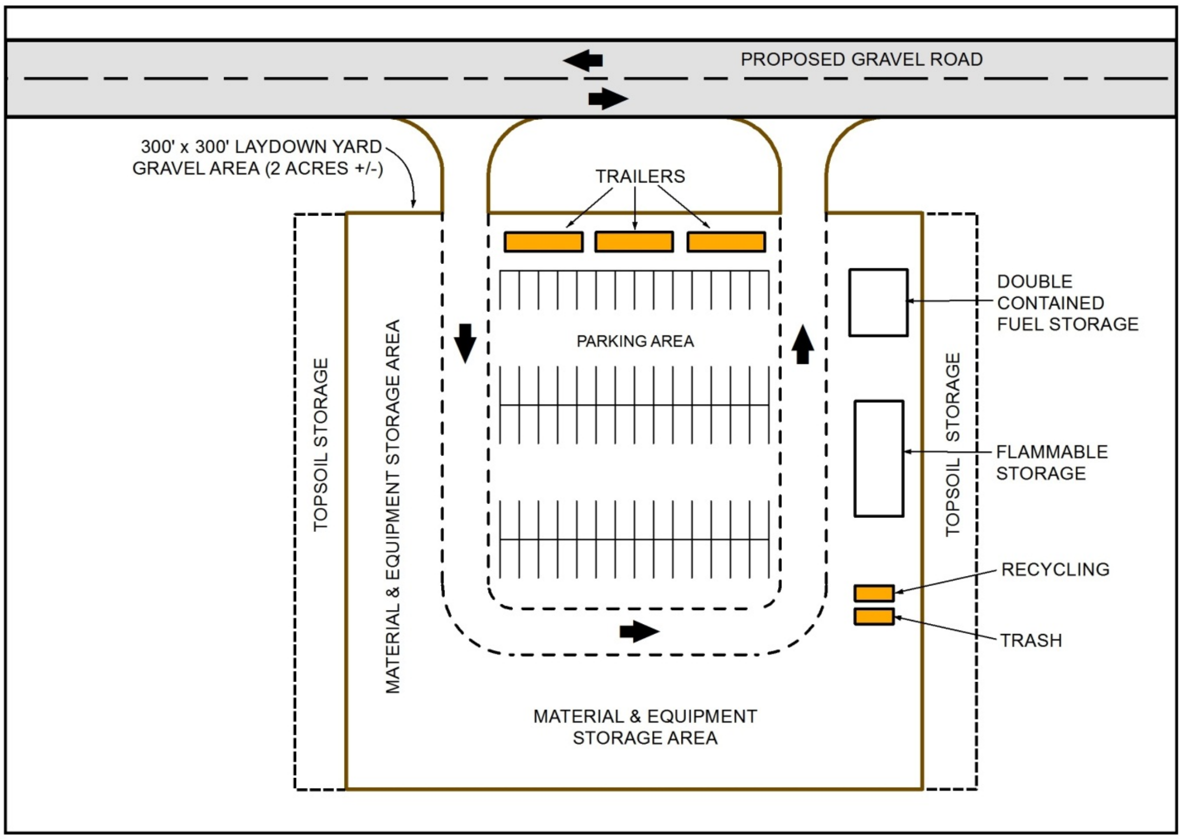

Figure 4-28. Typical Laydown Yard Arrangement

PCW will install lights at the laydown yards for security and safety. The lights will only be used when there are personnel present or there are components or materials stored in the area. The lighting will consist of portable light plants with telescoping booms set high enough to limit shadows, but low enough for effective lighting (typically 20 ft above ground level). Lights will have downward shields and motion detection will be used where such control is compatible with safety. Portions of the laydown yards containing higher value items may also be fenced using temporary fencing.

4.3.11.2 Crane Assembly Area

The large cranes used for wind turbine assembly and erection will be brought to the wind turbine installation areas via flatbed semi-trailers and assembled on-site. Similarly, when such a crane is no longer required in the area, the crane will be broken down and loaded back onto the flatbed trailers for relocation to another area or removed from the CCSM Project Site. To support crane assembly and breakdown, crane assembly areas are required. An example of a crane assembly area in use is shown in Figure 4-29.

Figure 4-29. Crane Assembly Area

Crane assembly areas need to be graded to a consistent slope of no more than 1%, be 400 feet long, at least 100 feet wide, and be connected to roads that have crane shoulders or temporary crane paths. A typical crane assembly area layout is shown in Figure 4-29, as well as the Phase I Wind Turbine Development Issued for Permit Plans in Appendix B.

PCW has located crane assembly areas within the limits of disturbance for other CCSM Project elements to the extent practicable. However, grade constraints, construction sequencing, and other factors can require assembly areas in other locations. PCW has selected crane assembly areas to minimize grading beyond what is required for the access roads. Where possible, crane assembly areas are located adjacent to turbine pads so the area can be used for multiple purposes.

4.3.11.3 Crane Path

As mentioned in Section 4.3.1 and the CCSM Project Road Design Manual (Appendix C), turbine roads and arterial roads will have crane shoulders to facilitate crane travel throughout the CCSM Project Site. In certain locations, it may be necessary to build additional temporary crane paths that do not follow roads. These crane paths will be used to move cranes from one turbine location to another where road routing is impractical, and where moving the crane along the turbine roads would add significant distance and other complexities to the crane travel. PCW has included crane paths in the disturbance estimates for the Phase I Wind Turbine Development and Issued for Permit Plans in Appendix B.

The temporary crane paths are designed to minimize impacts to steep slopes and drainage crossings. For most crane paths existing vegetation will be lowered or removed and the existing native material will be compacted. For purposes of planning and permitting, PCW assumes that vegetation clearing and compaction will occur for all crane paths. Crane paths typically go straight up and down terrain rather than across it due to the cross slope requirements of cranes needing to be flat or up to 1%. Some grading for crane paths will be required to adjust cross slope, smooth out existing grade changes, and keep crane paths to a maximum grade of 14%. Gravel is not anticipated to be needed for temporary crane paths. Drainage crossings that are encountered will either have a temporary culvert installed based on a 1 year storm event (for incised drainage), or timber crane mats installed (for shallow broad drainages). Drainage crossings will be constructed per the requirements of the Storm Water Pollution Prevention Plan (Appendix I). The crane paths are temporary and will be decompacted and reclaimed upon completion of their use.

4.3.11.4 On-Site Accommodations

In the event that temporary on-site accommodations are required for the CCSM Project construction, PCW is prepared to provide on-site workforce accommodations. These accommodations include a construction camp and recreational vehicle (RV) park. All temporary on-site accommodations will be located within the North laydown yard (Figure 4-30). These accommodations are described further below.

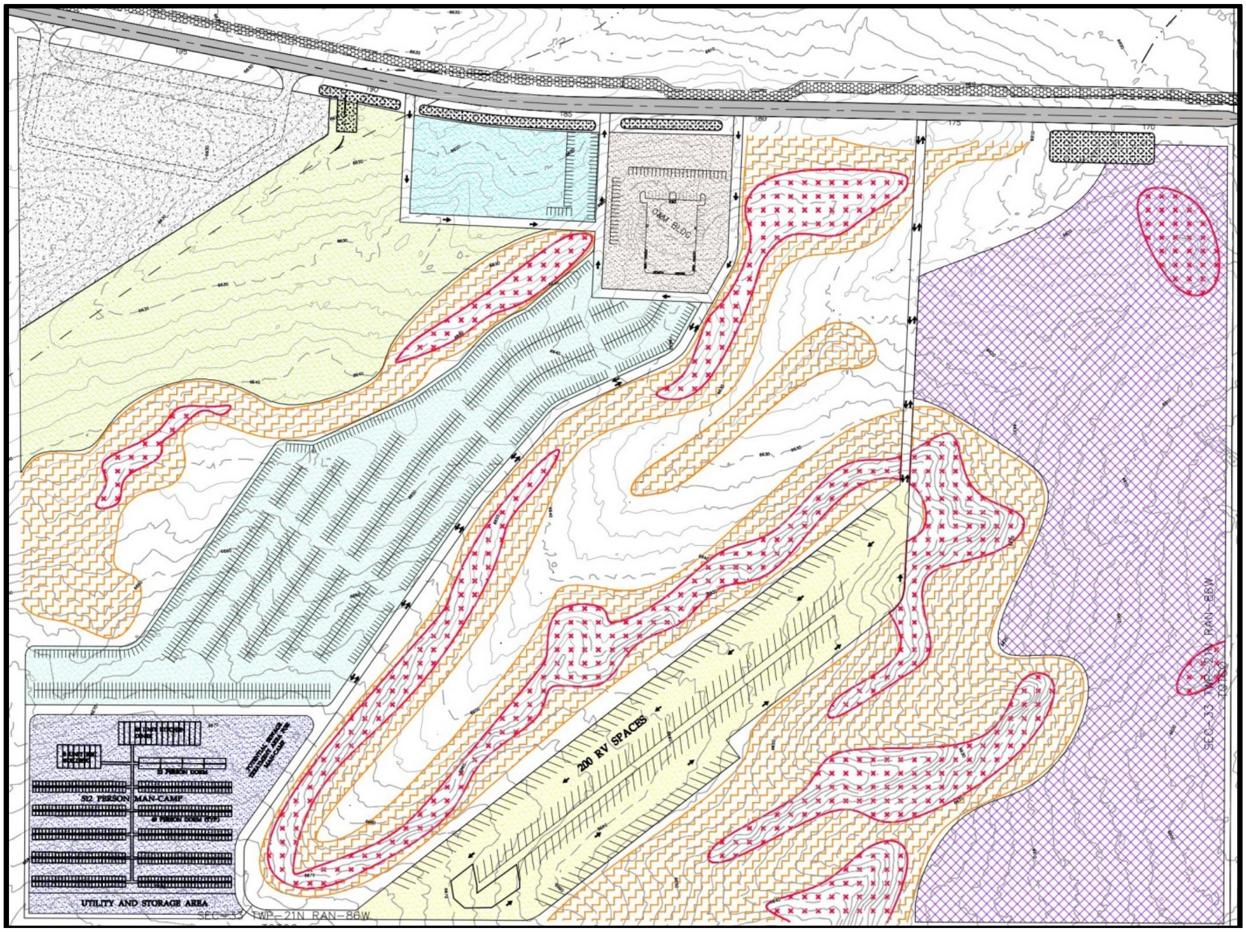

Figure 4-30. On-Site Accommodations Arrangement in North Laydown Yard

4.3.11.4.1Construction Camp

Typical construction camp designs include pre-fabricated modular dormitory “pods,” each with individual quarters and common bathrooms. Some camp designs include suites with individual bathrooms. Camps also commonly include recreation and cafeteria modules. PCW has evaluated different configurations for the construction camp, and found sufficient room exists in the area identified in Figure 4-30 and Figure 4-31 for camps sized up to 500 or more residents. The Phase I Wind Turbine Development design is based on a construction camp for approximately 250 workers. Figure 4-31 shows two preliminary site plans for construction camp arrangements for just over 250 and 500 residents (the exact number will be based upon the design of modules installed). Pictures of typical construction camps for other projects are shown in Figure 4-32.

PCW will mobilize the construction camp pods as needed to meet workforce housing demands. Modules will be connected to utilities as described in Section 4.3.10.

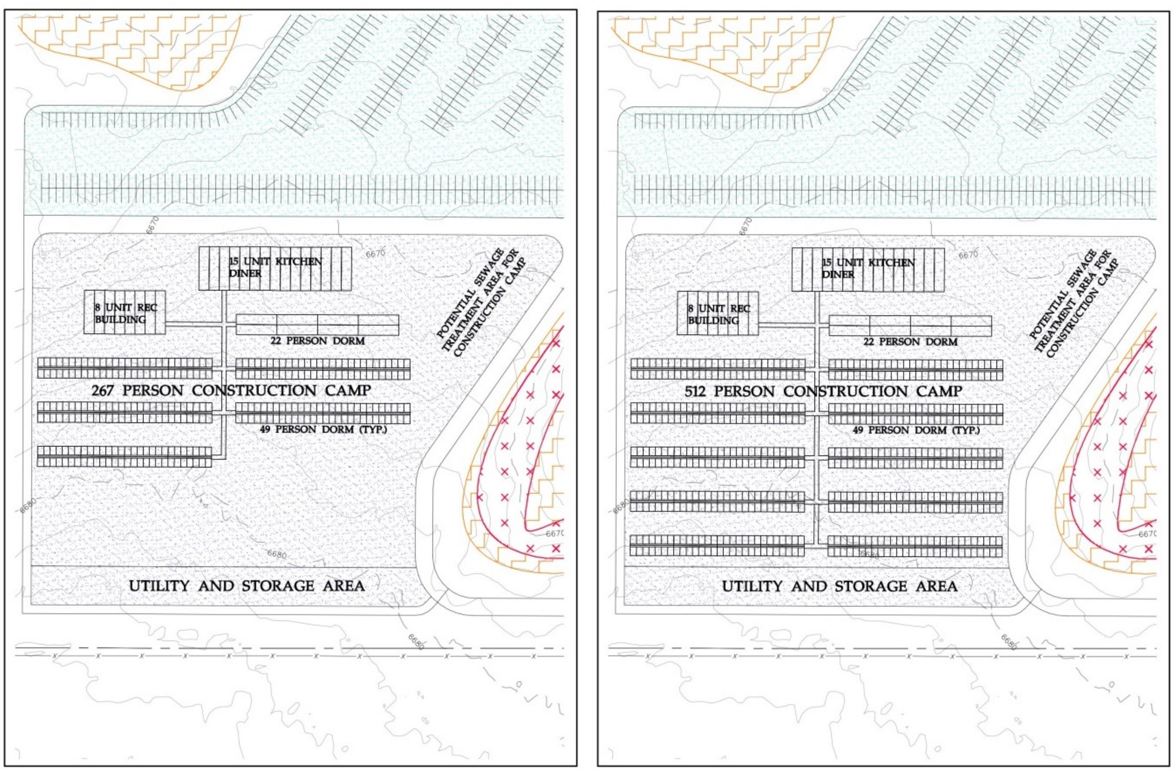

Figure 4-31. Construction Camp Preliminary Site Plans

Figure 4-32. Typical Construction Camp Pictures

4.3.11.4.2RV Park

The CCSM Project on-site RV park will include gravel sites for each RV with sufficient room for both the RV and towing vehicle. Hookups for each RV will include electrical service, potable water, and sewer connections. Figure 4-33 shows a layout for up to 200 RV sites adjacent to the construction camp within the North laydown yard. A typical RV park and example of combined RV park/construction camp is shown in Figure 4-34.

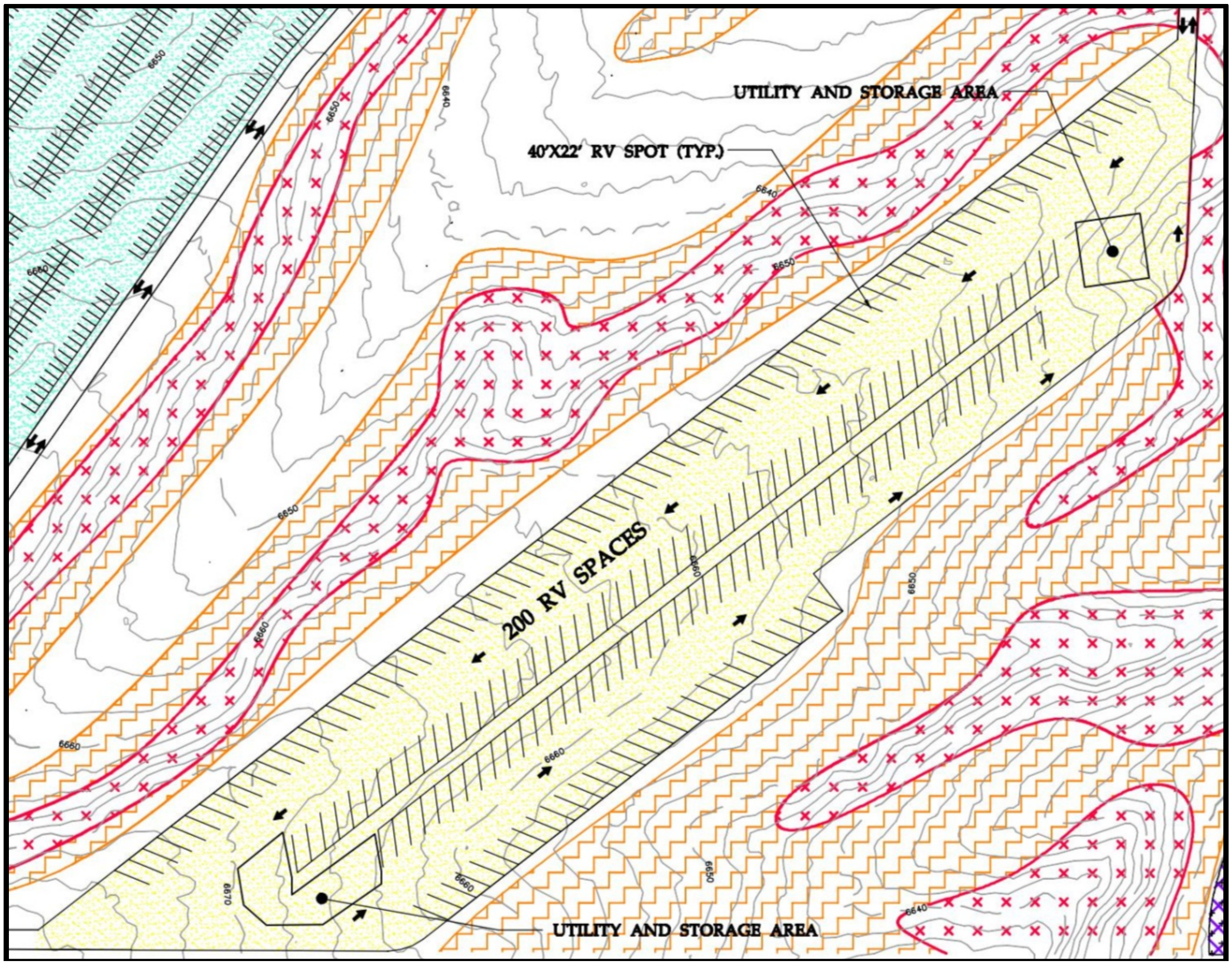

Figure 4-33. RV Park General Arrangement

Figure 4-34. Typical RV Site Pictures